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PRACTICAL AND PATHOLOGICAL RESEARCHES

ON

THE VARIOUS FORMS OF PARALYSIS.



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AND
PATHOLOGICAL RESEARCHES
ON THE
VARIOUS FORMS OF PARALYSIS.

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LONDON:
JOHN CHURCHILL AND SONS, NEW BURLINGTON STREET.

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ON THE

VARIOUS FORMS OF PARALYSIS.

CHAPTER I.

ON THE MINUTE STRUCTURE OF THE NERVOUS CENTRES.

IF it be permissible to write on a symptom which is common to many forms of disease, surely the disunion of the link which associates the conscious mind with the external world, or which transmits the power to execute the actions directed by the internal will, is of sufficient importance to claim an interest commensurate with these obscure and complex processes of organic life.

It is not my intention to enter into any historical account of the successive steps which have been made in the progress of the physiology and pathology of the nervous system ; but it would be unseemly to forget the homage which is due to two great men who conceived the plan and laid the foundation of those sciences.

Up to the end of the first decade of the present century, it was universally believed that every individual nerve, to whatever part of the body it might be distributed, proceeded from the brain as from a common centre, of which all parts were supposed to possess the same complex properties, and to endow the nerves with the same attributes.

To Sir Charles Bell is due the honour of having first demonstrated the fact that there are nerves of sensation distinct from nerves of motion, and that each set has a special origin in or connexion with the brain and spinal cord. He underrated, however, the important function of this latter part of the

nervous centre, and regarded it simply as a main channel to convey the nervous currents to and from the brain; the conductors of sensation passing, as he thought, through the posterior and lateral columns—the conductors of volition through the anterior columns of the cord; and it was impossible, without the experiments which have since been made, that he could arrive at a correct notion on these important points.*

But his theory immediately suggested the obvious means of tracing back to particular parts of the brain the causes of paralysis, and of many nervous diseases. It did not, however, account for those strange and mysterious sympathies by virtue of which the different parts of the body are maintained in a state of mutual dependence, and by means of which a disturbed condition of one organ produces impressions on the other, and, it may be, distant parts of the system. What, for instance, but this kind of affinity can occasion the contracted brow in severe headache, the dilated nostrils in painful affections of the chest, or the raised upper lip, stretched over the gums, in great suffering of the abdomen? These and other far more important phenomena were interpreted by the thoughtful experiments of Dr. Marshall Hall, who first taught us that they are dependent on diffusion of excitement, not by the nerve primarily affected, which acts only as a conductor of sensation to the nervous centre, but by the nervous centre itself, on which the primary impression impinges, and from which it is reflected: that there is, in point of fact, a distinct and separate centre of nervous action in the spinal cord itself, independent of the brain. Thus a worm in the intestine sets up irritation, which, when transmitted to the spinal cord by the special conductors of sensation, may produce paralysis as a reflex action.

This theory, second only to that of Sir Charles Bell for its

* Majendie tested the truth of Sir C. Bell's theory by a series of experiments, and furthermore discovered that by irritating the anterior roots of the spinal nerves he induced pain, and that sometimes, too, local movements occurred when he irritated the posterior roots. In 1839 he observed that if the anterior roots be divided, it is the distal end only, when irritated, which produces pain: hence he concluded that it is an afferent conductor. He furthermore observed that if the posterior root be divided, the irritation of the anterior root no longer gives pain. From these facts he inferred that the nervous irritation which causes pain passes first to the peripheral branches, and then back again to the spinal cord; and to this he gave the name of recurrent sensibility.

practical importance, has been followed by much philosophical research concerning the structure and function of nervous tissue; but in no respect have the labours of Dr. Marshall Hall been of greater service than in the elucidation and treatment of reflex paralysis.

We have, chiefly by the discoveries of these two men, established on a physiological basis the separation of paralysis into a direct and a reflex form, and pathological cases have verified the principle on which the distinction is founded.

One great impediment to the investigations of pathologists has been in some degree removed by the recent researches of anatomists into the structure and relationship of the several parts of the nervous centres; and throughout the whole domain of pathology I know of no field which still promises a richer harvest of facts immediately applicable to practice than that in which a knowledge of the healthy and morbid structure of the brain and spinal cord is cultivated. It is not too much to say that every new fact which has been disclosed to us concerning the distribution of nervous fibres has elucidated some previous unrevealed phenomenon observed in disease, and still there is an insufficiency of anatomical evidence for the interpretation of many morbid phenomena.

I shall, therefore, begin with a concise account of the structure of the nervous centres; and first, of

The Spinal Cord.

This is divided by an anterior (α) and a posterior (β) fissure into two lateral halves; each half being intersected by the posterior or sensory nerve-roots into an anterior (γ) and a posterior (δ) column. The two posterior columns are regarded as the conductors of impressions of sensation to the brain; the two anterior are the conductors of the orders of the will to the motor nerves. Each lateral portion of the entire cord consists internally of grey matter which spreads out before and behind into two horns or cornua, an anterior (ζ), and a posterior (η). These cornua vary in form in different regions of the spinal cord, but the disposition of their constituent parts is well-nigh the same in all. The two halves are perfectly symmetrical, and

they are connected together by two commissures (δ , ϵ) between which a central canal (θ) extends from one extremity of the cord to the other.

In both the anterior and posterior cornua there are many multi-polar ganglionic cells (κ) united to one another by a network of nerve filaments. These nerve-cells are by far the most interesting anatomical elements in the animal body. They are the origin or the terminus of every nerve-fibre, and impart to all such fibres their peculiar endowment. Yet in structure nerve-cells are very simple, being made up of a cell-wall, with two or more caudate prolongations, a nucleus and nucleolus, and containing a few granular molecules.

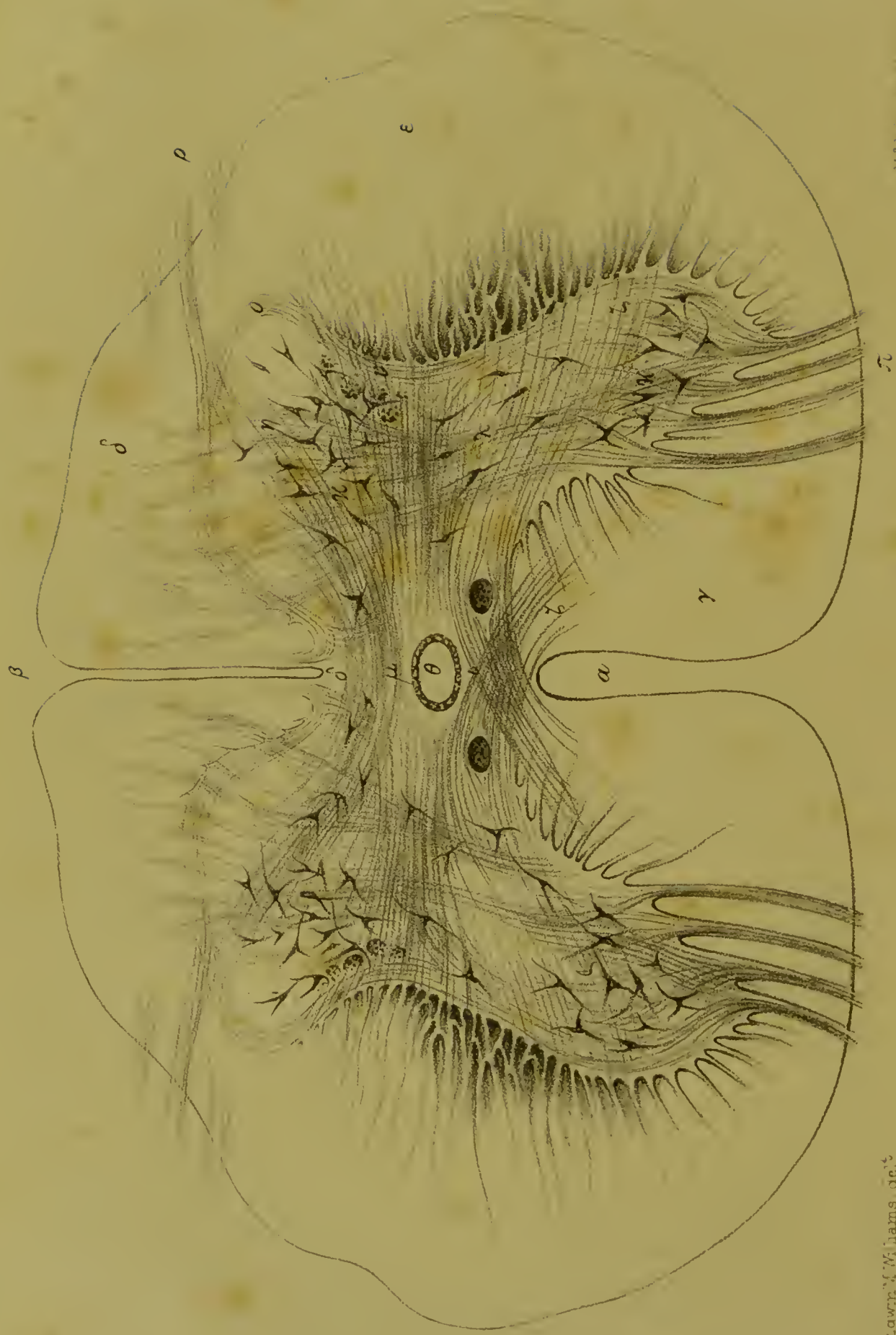
The nerve-fibres consist of an external membrane, of the white nerve-matter, and of the simple axis or cylinder. The existence of this latter character is denied by Funke, who attributes the appearance to a change which takes place after death—a contraction of the nerve-matter; but the nerve-matter itself is composed of a material similar to and continuous with the contents of the nerve-cell.

From the cells, the number of which is in direct ratio to the number and thickness of the nerves with which they are connected, fibres may be traced into the anterior and posterior roots of the spinal nerves, as we shall presently see.

There are other nerve-fibres in the grey substance, which have been described by my friend Mr. Lockhart Clarke,* in transverse and longitudinal orders.

The *transverse* are disposed in an antero-posterior (λ) and latero-transverse (μ) directions. The antero-posterior, proceeding from behind forward, may be traced through the posterior white columns partly into the posterior roots of nerves on the same vertical plane, partly into other nerve-roots above and below. Others pass into the anterior cornua, where they interlace and form a network, in the meshes of which the multi-polar cells are contained. Some extend outwards to the lateral white columns, whilst many others appear to be continuous with the anterior roots of nerves. Others cross obliquely in front of the spinal canal, where they decussate with similar fibres from the opposite side, and penetrate into the anterior columns.

* "Philosophical Transactions for 1851," vol. 141, pp. 607—621.



Lawrence Williams, dec'd

Q. 6. E. 27. 1811.

These antero-posterior nerve-fibres, therefore, connect together several posterior roots of sensitive nerves; the posterior with the anterior cornua; the posterior columns with the lateral and anterior; one half of the spinal cord with the other; and, finally, the posterior nerve-roots with the anterior.*

The *latero-transverse* fibres (μ) are arranged in loose bands, disposed more horizontally, and pass from one side of the grey substance to the other. Those behind the spinal canal diverge on each side into the anterior and posterior cornua, and, from them, into the lateral and posterior columns. Some pass from one posterior nerve-root to its fellows on the opposite side; whilst others, in front of the spinal canal, connect the anterior nerve-roots in a similar manner. A few may be traced from the anterior roots into the lateral columns of the opposite side.

These latero-transverse fibres, therefore, constitute the transverse commissure, and establish a communication between the opposite sides of the spinal cord on the same vertical plane. The experiments of Dr. Brown-Séquard have proved that the decussation of the nerves of sensation takes place in the spinal cord: hence it is probable that these latero-transverse fibres are the conductors of the impressions of sensation from one side of the body to the opposite side of the spinal cord.†

There are besides, in the grey substance, numerous *longitudinal* fibres, which are chiefly collected together in the so-called substantia gelatinosa (ν). These longitudinal fibres are intimately connected with the posterior nerve-roots and with the latero-transverse fibres [marginal fibres of Van der Kolk (o)], which surround the posterior cornua.

The bundles of these longitudinal fibres are thicker at the lumbar and cervical dilatations of the cord; therefore it is very probable that they are not continued individually as far as the brain; but, as Van der Kolk has suggested, that they may con-

* In these connecting fibres may we not have the links which virtually make the afferent and efferent nerves continuous? the sensory nerve being changed in its function through the grey substance into the efferent nerve which excites the muscles to reflex action.

† In Stilling's experiments on the spinal cord, it was found that when division of that organ was made along the median plane, a stimulus applied to one leg caused reflex contractions of that leg only, and none of the other. The power of transmitting organic changes from one side of the cord to the other was destroyed by the section of the commissure.

tain fibres which connect groups of ganglionic cells at different heights in the anterior cornua, and so, perhaps, serve for the co-ordination of muscular motion. If this be so, we have nerves of sensation becoming excitors of motion; but in losing their character as sensitive nerves, the change is dependent on their combinations with multipolar cells, from which they transfer their reflex power of innervation.

Stilling fancied that he had made out some longitudinal fibres in the anterior cornua; and in many careful examinations which I have made during the last six years, I am satisfied that I have seen such fibres.

The *white longitudinal columns* surround and inclose the grey matter; and, by the intersections of the anterior and posterior roots of nerve, each side is divided into an anterior, a lateral, and a posterior column.

The *anterior columns* consist of longitudinal tubular nerve-fibres, and of transverse fibres, by which they are penetrated. They have no proper commissure, although they are united in the centre, at the bottom of the anterior fissure, by decussating nerve-fibres, which pass from the grey substance on one side through the raphe, into the anterior column of the opposite side (ζ).

The *lateral columns* are contained between the anterior and posterior roots of the spinal nerves; and in addition to the longitudinal fibres, of which they are chiefly composed, they are penetrated by filaments from the transverse commissure, and by others from both anterior and posterior nerve-roots (ϵ).

Now, the *anterior nerve-roots* (π) traverse the antero-lateral columns in distinct bundles until they reach the grey substance; and there the ultimate filaments diverge in every direction, each one, if carefully followed, being traceable to a multipolar ganglionic cell; and these cells increase in number at every point where the roots of the nerves enter the spinal cord. Thus it is that in the grey matter of the cord we may recognize a series of ganglionic masses, which are the centres of action of the spinal nerves.

The decussating fibres of the anterior commissure having communicated with the ganglionic cells, penetrate deeply into the anterior columns; and Van der Kolk has figured a multi-

polar cell which he observed to connect the longitudinal tubular fibres with the penetrating transverse filaments. He has also observed that the innermost longitudinal fibres of the anterior columns curve towards the grey substance, and pass into ganglionic cells of the anterior cornua.

On these anatomical grounds, he inferred that each longitudinal fibre of the anterior columns is the conductor of the orders of the will to a group of reciprocally connected multipolar ganglionic cells, from which the motor nerves derive their origin; and that the influence of each fibre may be communicated directly to the cells by the fibre itself, or transmitted indirectly by the penetrating commissural filaments which communicate with both.

The *posterior columns* (δ), which are contained between the posterior nerve-roots, are comparatively small, and, like the anterior, possess no proper commissure of their own; for the posterior fissure (β), which separates the posterior columns, reaches down to the posterior border of the transverse commissure of the grey substance. They are chiefly constituted of longitudinal tubular fibres derived from the nerve-roots, and of transverse filaments from the posterior border of the transverse commissure.

The *posterior nerve-roots* (ρ) do not traverse the posterior columns in distinct bundles, like the anterior roots, but on entering the cord they split up into three kinds of fibres, which have been minutely described by Mr. Lockhart Clarke.* The first kind enter the cord transversely, and pursue a transverse course through the posterior columns into the grey substance, where they bend on themselves at right angles, and pass in a longitudinal direction, some upwards, others downwards, joining corresponding fibres from the other roots above and below, and thus form a continuous longitudinal band in the *substantia gelatinosa* (ν). From this band are derived many, if not all, of the antero-posterior nerve-fibres in the grey substance which have been described.

A second kind of fibres traverse the posterior columns transversely, and expand themselves in the grey substance, as the latero-transverse fibres, which have also been described.

* "Philosophical Transactions," 1853.

The third kind of fibres enter the cord obliquely, and immediately spread out in different directions; some fibres passing into the posterior cornua, whilst others diverge and take a longitudinal course, either downwards or upwards, within the posterior white columns: but whether any of these latter are continued as far as the brain, is a question which has not yet been determined. Wagner regards them as purely sensitive fibres which, without being connected with the ganglionic cells in the spinal cord, pass directly upwards to the brain, and there excite sensation.

But experimental observations and pathological cases are not wanting to show that the anterior columns are not the exclusive conductors of the influence of the will to the anterior nerves, and that the posterior white columns are not the sole channels of communication between the posterior nerves and the brain.

With respect to the anterior columns, an explanation is afforded by the connecting links which have been described between the anterior roots and the longitudinal fibres in the anterior cornua; and a more obvious clue is given to account for the transmission of sensation—at least as far as the spinal cord is concerned—by the course and distribution of the posterior roots, and by the longitudinal nerve-fibres contained in the grey substance.

Dr. Brown-Séquard has been led, by his experiments, to the conclusion that the transmission of sensitive impressions to the sensorium takes place by both cells and nerve-fibres united together,* but that the grey matter is the principal conductor of the sensitive impressions in the spinal cord. The very objection, however, which he admitted in opposition to Longet, who supposed that the sensorium received sensitive impressions only from the posterior columns, exists to a greater degree in respect of the notion that cells transmit such impressions.

* “Lectures on the Physiology and Pathology of the Central Nervous System, delivered at the Royal College of Surgeons of England in May, 1858,” p. 23.—Herein Dr. B. Séquard describes the result of making a transverse incision of the posterior columns of the spinal marrow as inducing hyperæsthesia behind the section; from which he infers that the posterior columns of the spinal cord and medulla oblongata are not the channels for transmitting sensible impressions from their periphery to the brain; but if the grey matter be divided, as well as the posterior columns, then sensibility is lost.

The objection to the views of Longet was first propounded by Dr. R. B. Todd, who contended that the posterior columns are not, as they should be, according to the theory, larger the higher they are examined in the spinal cord: but Mr. Lockhart Clarke has shown that the longitudinal fibres of the lateral columns, which contain sensitive nerves, *do* gradually increase as they ascend in the cervical region, and that the posterior cornua gradually become narrower.*

On these anatomical considerations, therefore, together with others which have been stated, there is reason to infer that the ganglionic cells and their intermediate filaments transmit their influence across the cord, and that the longitudinal nerve-fibres are the conductors of impressions to and from the encephalon; the incident or sensory fibres changing their function during their passage through the grey matter in the brain, and becoming volitional, or channels through which the determinations of the will are conveyed to the motor nerves, as above described.

In the immediate neighbourhood of the origin of the fourth pair of cervical nerves (the phrenic), Mr. Lockhart Clarke has traced the commencement of the spinal accessory nerves, from filaments which proceed from a group of cells contained in a network of minute blood-vessels on the outer part of the posterior cornua. This group of cells ascends towards the medulla oblongata, in an inward direction, towards the space behind the canal, and there contributes to form the nucleus which gives origin to the highest roots of the nerve. The lower filaments, after traversing the grey substance, unite with others which originate from caudate cells in the anterior cornua, through which they pass upwards in company with the roots of the anterior nerves to the medulla oblongata.†

Between the filaments which connect the above group of cells

* "Philosophical Transactions," 1851.

† "Philosophical Transactions," 1861. These facts confirm the idea enunciated some years ago by Mr. Bowman, that the implantation of the spinal accessory in different parts of the nervous centre endows it with the property of bringing the sentient surface of the lung into immediate relation with the roots of all those nerves which animate the great muscles of respiration, the phrenic, the external thoracic, the cervical plexus, the motor fibres of the vagus and of the spinal accessory.

with those of the anterior cornua, Mr. Clarke has traced some of the roots of the facial nerve. In this course they are probably brought into connexion with the respiratory centres; and thus have we an explanation of the mechanism by which impressions made on the vagus, and on the incident fibres of the tri-facial and spinal nerves, may call into action the whole class of respiratory muscles.

At about the same vertical plane of the spinal cord, the central canal begins to incline backwards by a change in the relative position of parts, which we have now to consider.*

Medulla Oblongata and Mesocephale.

At the junction of the spinal cord with the medulla oblongata, the relative position of the elementary parts of the cord is changed.

The anterior columns thrust themselves backwards and upwards, pushing, as it were, the lateral and posterior columns aside, and become continuous with the *corpora pyramidalia*.

The transverse commissural band behind the central canal, connecting the posterior cornua of the cord, disappears; and thus it is that the posterior columns divaricate, and the canal terminates in the fourth ventricle.

The anterior cornua, following the backward direction of the columns, are eventually found immediately below the floor of the fourth ventricle, where, according to Stilling, the nuclei of the hypoglossal, of the sixth, seventh, fourth, and third pairs of cerebral nerves are located, close to the middle line, and from which nuclei these several nerves derive their origin.

The two lateral and posterior columns being thus pushed aside, pursue a forward and upward direction, and become continuous with the *corpora restiformia*, which are situated on the sides of the medulla oblongata; but, turning from the higher parts of the medulla in a forward direction, they pass into the pons Varolii. Here they diverge again, each restiform body passing through the middle of the crus cerebelli into the hemisphere of the cerebellum of the corresponding side, from whence

* See fig. 396 of the "Cyclopædia of Anatomy and Physiology," vol. iii., p. 708: also Schroeder van der Kolk "On the Medulla Oblongata," Plate 2, fig. 2 A.

other fibres pass into the *processus cerebelli ad testem*, overlying the fibres from the restiform body, and therefore composing the superior layer of the *crus cerebelli*.

The inferior layer is formed by fibres which pass from each hemisphere of the cerebellum transversely across the inferior surface of the mesocephale, or pons, where they occupy the same relative position with respect to the fibres of the *corpora restiformia* as they do in the *crura cerebelli*. These transverse fibres are the commissures of the cerebellum.

The posterior cornua, following the direction of the posterior columns, pass forward and upward, gradually increase in bulk, and terminate in the grey tubercles of Rolando. In these bodies a multitude of caudate cells form a network of nervous matter, in the meshes of which are contained bundles of longitudinal nerves which are continuous with the white columns.

Together with the *corpora restiformia* there are two bundles of longitudinal fibres—the posterior pyramidal columns—which descend from the cerebellum on the inner border of the restiform bodies. They are not continuous with the posterior or sensitive columns, but are derived from the cerebellum, from which they descend, and in their course form the sides of the fourth ventricle. These fibres resolve themselves into transverse or commissural fibres in the medulla oblongata.

The *corpora restiformia*, in their course through the medulla oblongata and mesocephale, contain the nuclei of the nerves of sensation,—namely, of the vagus, the glosso-pharyngeus, the auditory, the sensitive roots of the trigeminus, and, as Van der Kolk has said, “we might even add the optic nerves from the *corpora quadrigemina*, and the olfactory, both of which arise more to the side of the middle line.”*

That the nerve-current of the *corpora restiformia* is an ascending one in the medulla oblongata, has been proved by the experiments of Dr. Brown-Séguard, who, in cutting through one-half of the medulla, found that the portion of the restiform body above the incision was deprived of sensation: and that there is an opposite direction of the molecular influence above the pons Varolii, appears equally well established by the experiments of Szokalski, who, on removing the cerebral and cere-

* Moore's Translation of Professor Schroeder van der Kolk, page 92.

bellar connexions from the pons, found that he had not destroyed the sense of feeling. Hence it is highly probable, as Van der Kolk has suggested, that the seat of sensation is in or about the medulla oblongata.

The *corpora olivaria* consist externally of longitudinal fibres derived from the optic thalami and corpora quadrigemina, where they may be traced backward through the mesocephale, on a plane superior to that of the corpora pyramidalia, to the grey vesicular matter of the corpora olivaria.

From the corpora ciliaria, or dentata, numerous fibres pass inwards to the nuclei of the hypoglossal nerves; and from these nuclei, as well as from every portion of the grey matter, transverse fibres pass through the raphe—the seat of a very complicated decussation between the posterior halves of the medulla, on the one hand, and between each of these and the corpora olivaria of opposite sides, on the other—to corresponding parts of each side. Thus, the corpora olivaria are united in the middle, between the corpora restiformia and the corpora pyramidalia.

The corpora olivaria are more highly developed in man than in any of the lower animals; and although the medulla oblongata bears some relation, as to its size, with the bulk of the entire body, yet is that size determined by the corpora restiformia and the corpora pyramidalia.

The nuclei of the hypoglossal nerves, however, and the corpora ciliaria obtain their maximum of development in man; and Van der Kolk argues that the delicate combinations of motion in the human tongue in articulation and speech afford an explanation of the great size of the olivary bodies, and of their intimate connexion with the nuclei of the hypoglossal nerves. He has adduced some illustrative instances of atrophy of the corpora olivaria, and of structural diseases of those organs, to prove that they are subservient to the articulation of sound.*

The Corpora Pyramidalia.—From the corpora striata chiefly, and also from the optic thalami, numerous tubular fibres pass backward through the crura cerebri into the pons Varolii and medulla oblongata, where they constitute the corpora pyramidalia. In the pons, or mesocephale, these fibres immediately overlie the transverse fibres which have been described as pass-

* Moore's Translation, pp. 149—169.

ing from each hemisphere of the cerebellum. With the deeper seated of these latter, a curious interlacement occurs, by the longitudinal fibres passing alternately above and below them, and in the meshes of this interlacement numerous patches of grey vesicular matter exist; but these latter are nowhere seen where there is no interlacement, as in the lowest and most superficial layer of fibres, which are exclusively transverse.

In their outward course the fibres from the nuclei of the abducent and hypoglossal nerves communicate, by means of ganglionic cells, with the fibres of the corpora pyramidalia.*

Towards the inferior extremity of the medulla oblongata, the fibres of the corpora pyramidalia are divisible into three distinct kinds:—1. The decussating fibres which pass downward and backward into the antero-lateral columns of the spinal cord on the opposite side, so that the right pyramid sends fibres into the left side of the cord, and the left pyramid into the right side of the cord. These decussating bundles of fibres are, doubtless, the channels through which the mandates of the will are conveyed to the four extremities: and that they are so, is proved by the experiments of Dr. Brown-Séquard, who, on dividing the whole of these decussating fibres, produced entire paralysis of all the limbs. 2. A few fibres which are continued from the pyramids directly down to the anterior surface of the cord on the same side. These latter are continuous with the antero-lateral column, and appear to serve the purpose of establishing a direct communication between each half of the medulla oblongata and the corresponding half of the spinal cord. 3. The cruciform fibres, which curve round the corpora olivaria, and appear to incorporate themselves with the corpora pyramidalia in front, and with the corpora restiformia behind, and are thus the superficial connecting fibres between the anterior and posterior parts of the medulla.

In man, quadrumana, and carnivora, the corpora pyramidalia are larger in proportion to the size of the body than in hoofed animals, probably in consequence of the more varied motions of the fingers and toes; and the decussating fibres of the pyramids are more numerous in man than in any of the inferior animals.

* The nucleus of the hypoglossus and the passage of the fibres through the fibres of the corpora pyramidalia are beautifully shown by Stilling in his Illustrations of the Pons Varolii, Plate 3, h, u, P.

On the Nature of Nerve-Force.

The anatomical connexion between the sensitive posterior columns of the spinal cord in their entirety and the cerebellum, the extension of nerve-fibres from the cerebellum to the corpora quadrigemina, and from these bodies to the optic thalami, are facts which indicate the existence of close physiological relationship between these parts; and I venture to assume that it is through these channels that objective sensations are conveyed to the cerebrum, the centre of volition; that from the ganglionic cells contained in the corpora striata and optic thalami the mandates of the will are extended through the vesicular matter of the crura cerebri, of the pons Varolii, and of the medulla oblongata, to the anterior horns of grey matter contained in the spinal cord, by means of the corpora pyramidalia and the anterior columns of the cord, the fibres of which communicate directly or indirectly with the ganglionic cells of the anterior cornua, which become the excitors of muscular motion; that the transverse fibres in the mesocephale and medulla oblongata, which are almost if not quite as numerous as the longitudinal, serve as conductors of the orders of the will to the nuclei of motor nerves for the consentaneous action of corresponding muscles in the movements of the face and tongue for expression and speech, in the contractions of the gullet for deglutition, and in the movements of the ribs for respiration.

But how are these several acts performed? In other words, what is the nature of that mysterious nerve-force which, beginning its physical career in the organs of sense, passes to the sensorium, where it becomes an object of consciousness, and, operating on the cerebrum, engenders actual ideas or volitions, which are transmitted to the spinal cord, and there excite muscular motion?

Is it simply electricity, in the development of which every minute molecule of nervous matter, by virtue of a dipolar attribute, adds its quota to the evolution of an electric current?*

* In 1822, Dr. Wilson Philip communicated to the Royal Society a paper in which he showed that by dividing the eighth pair of nerves, he arrested digestion, and produced difficulty of breathing; but that by sending a galvanic current through the lower portion of the divided nerve, he restored its healthy function.—“Proceedings of Royal Society,” Part I., p. 23 (1822).

Or is it some other power, which may be represented by a given quantity, say of heat, which would be required to raise the temperature of a given quantity of water so many degrees as to produce a certain amount of mechanical energy or motion?

Many physiologists have embraced the latter opinion chiefly in consequence of the different behaviour of a muscle when under the influence of a nerve in a physiological active state, and when artificially placed in an electro-tonic state by the transmission of a constant galvanic current through it. In the first case, the muscle is kept in a constant state of contraction; in the electro-tonic condition, contraction occurs only on closing and opening the circuit. In the interval, the muscle is in a state of relaxation, and remains so.

This objection to the electric theory of nerve-force has been met by the proposition that animal electricity may exist in a static form; but Pflüger's investigations, to which I shall immediately have to refer, have resulted in the establishment of a theory of nerve excitation, strictly in accordance with the laws of muscular contraction.

Electricity is developed in some animal tissues in direct proportion to the size of the nerves; and M. Armand Moreau has recorded many experiments to prove the identity of the agent discharged from the electric organ of the torpedo with that discharged from a Leyden battery.*

Furthermore, it is well known that the galvanic current can be made not only to imitate the natural nerve-force, but that it may also replace it in producing many of the phenomena of life, and that these latter can only be explained by supposing that the development of nerve action is associated, if not identical with the assumption of a polar condition by the molecules of nerves.

In my "History of Medicine," it will be my duty to refer to many Italian physicians who have established these facts, but to no one more than Professor Matteucci, of Pisa, who has shown that a galvanic current affects both sensitive and motor nerves to a greater degree, when the current is made to pass through either in the direct or natural course of the nerve-

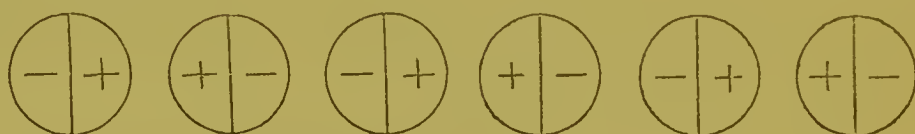
* "Expériences sur la Torpille Electrique," *Annales des Sciences Naturelles*, 4 series, t. 18 (1862).

force (centripetal in sensitive nerves, centrifugal in motor nerves), than when it is transmitted in the inverse or opposed course; that the excitability of motor nerve fibres is modified by their juxtaposition with sensitive nerve fibres (most nervous trunks being composed of both), and that electricity is developed during muscular contraction, the degree of electric excitement being in proportion to the energy of contraction.

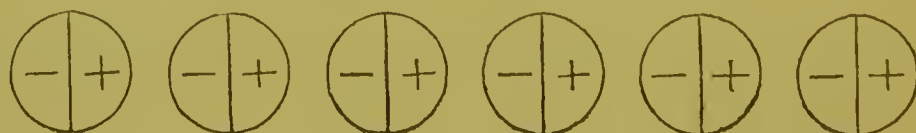
All these facts have been investigated by M. Du Bois-Reymond, whose great work on animal electricity forms a second era in that science.

All his experiments have been conducted with a galvanoscope, by means of which he has established the fact that every molecule of fresh excitable nerve is the source of electro-motive power, and that every part of a nerve acts in obedience to the same law as that which governs the function of the entire nerve.

He supposes that every nerve consists of a number of dipolar molecules arranged in couplets, and that in a state of rest the similar poles of each pair of molecules are turned towards each other, so as to represent the condition of a closed current, the negative poles being turned towards the extremities of the nerve, thus:—



In the active or electro-tonic state, he supposes that an electrolytic process takes place, and that the molecules arrange themselves so that the opposite poles are turned towards each other, the negative pole, —, being turned towards the point at which the current enters; the positive pole, +, towards the point at which the current leaves the nerve, thus:— *



* M. Du Bois-Reymond has also suggested that in a state of rest each nerve molecule may have its external surface in a positive, and its internal part in a negative, state of electricity; and that excitement or irritability may induce an opposite state of polarity; namely, a negative condition of the external, and a positive state of the internal part of each molecule,—an active or electro-tonic state.

Now, if the sciatic nerve of a living frog be dissected out from the muscles of the thigh, and the thigh removed, so as to leave the nerve in connexion with the spinal cord above and with the leg below, when the nerve is placed on the cushions of a galvanoscope, it produces a deflection of the needle.

If through the same nerve a constant galvanic current be passed in the same direction as the nerve-current, an immediate increase of the deflection of the needle takes place; but if the current be passed in the opposite direction to the nerve-current, an immediate decrease of the deflection is observed.

The reason assigned by M. Du Bois-Reymond is obvious. In the first case, the superinduced current is just so much added to the original nerve-force; in the second, it is just so much subtracted or neutralized by the opposed current.

On further investigation, by placing a transverse section of a nerve in contact with one cushion of the galvanoscope, whilst the longitudinal surface rested on the other cushion, a strong deflection of the needle indicated the course of an electro-motive current passing from the external surface to the transverse. Hence the external surface is shown to be positive (+) in its electric relations with the transverse, which is negative (—).

From this and other corresponding observations, M. Du Bois-Reymond inferred that the power in question acts according to a definite law, which may be stated as the law of antagonism of the longitudinal and transverse sections; the former being positive, the latter negative.

All this, however, did not diminish the objection which has been stated to the electric theory of nerve-force: therefore M. Du Bois-Reymond instituted other experiments, and discovered that if, instead of a continuous galvanic current, a series of instantaneous currents of high-tension electricity (Faradaic currents) be made to pass along a nerve connected with a muscle, the contractions follow each other so rapidly, that the muscle has no time to regain its state of relaxation, and a condition of continued contraction like that of tetanus is the result.

When examined by the galvanoscope, this interrupted current occasions the positive and negative deflections of the needle; but the positive variation is less than the negative (in the con-

stant current the positive variation is greater) : hence it would appear that in the tetanized nerve the characteristic phenomenon is expressed by a negative deflection.

The question remains, Is the tetanized nerve identical in character with the physiological active nerve? If it be, then a negative deflection of the needle is the expression of the natural nerve-current.

At this point Pflüger began his researches by examining the effects of a constant galvanic current, varying in strength ; and he discovered that by the weakest current he could establish, a continuous contraction of muscle may be produced ; that by a stronger current, but still so weak as barely to deflect the needle, tetanus may be produced ; and that a very powerful current produces no contraction at all except at the moment of closing and opening the circuit, the opening being followed by weak contraction only.

Hence he infers that the most important consideration in conducting these physiological experiments is the strength of the current employed : that an extremely weak current is the function of an active healthy nerve ; and that a very powerful current suspends the action, and perhaps even causes the death of the nerve molecules.*

He has furthermore shown that the phenomena of action, so far as the sensitive nerves are concerned, are the same as those in motor nerves, the direction of the current being, of course, reversed. A very weak centripetal constant current produces pain ; a very powerful current produces no pain.

There is, therefore, every reason to suppose that the law of current excitation in the sensitive nerve is analogous to that of the motor nerve.

In further illustration of this, Matteucci's experiments may be here mentioned. He has shown that by exposing a mixed nerve—say the sciatic—and by applying the positive pole of a weak galvanic current towards the spinal end and the negative pole on the peripheral end of the exposed portion of nerve, muscular contraction occurs, but no pain. If, however, the

* “ Untersuchung über die Physiologie des Electrotonus, von Eduard Pflüger.”
Berlin, 1859.

poles be reversed, so that the positive pole is brought in contact with the peripheral end and the negative with the spinal end of the nerve, then pain is produced, but no muscular contraction.

The peripheral termination of motor nerves, as connected with the ultimate muscular fibre, is a most interesting subject of inquiry. Kühne supposes that the nerve molecules always join the sarcolemma, and that the nerve molecules pass beneath the sarcolemma, so as to come into intimate contact with the contractile substance. To these nerve molecules he has given the name of peripheric nervous nodules.

Dr. Lionel Beale contends that the nerve-fibre is far more extensive than is supposed by Kühne; that it extends into the interstices of the ultimate muscle fibres, in the form of a most elaborate network; that the nerves never lose themselves in other tissues, or become continuous with them; that they are brought into close relation with muscular fibre by their nuclei, but never lose their distinctness as special nerve-tissue. And I think he is right.

If, then, we admit the existence of a current of nerve-force, we must also admit that every act of muscular contraction and every perception of sensation involves a given expenditure of nerve-force, a disturbance of electric equilibrium along the whole course of the nerve, and a corresponding movement to restore the equilibrium, an inverse sequence of phenomena being understood,—namely, a centrifugal disturbance in the case of muscular motion, a centripetal disturbance in the case of sensation, and in each case an inverse reaction to re-establish the equilibrium.

Pflüger's experiments have led him to conclude that one and the same irritant applied to a nerve acts more powerfully the further it is applied from a muscle in the case of a motor nerve, or from the spinal cord in the case of a sensitive nerve. His idea is that a progressive molecular movement is developed at all points of a nerve, so that the sum of force is greater at the extremity of a nerve along which an irritation has travelled than at the point where the irritation was applied.

Whatever the peculiar nature of the nerve-force may be, we know that muscles cannot act singly, but that the co-operation of a group is necessary to perform every movement of the body,

whether it be made for locomotion, respiration, deglutition, or any other special motion for which the muscles are intended; and there is great reason to suppose that such consentaneous action results from the functional activity of separate groups of ganglionic cells in the spinal cord—each group being strung together by nerve-fibres like the jars of a Leyden battery—which transmit their influence through the motor nerves. Each group is probably excited to action by a longitudinal nerve-fibre which conducts the mandates of the will to the organ of co-ordination; and thus the telegraphic nerve-fibres in the anterior columns are relatively few to the number of motor nerves which proceed from the spinal marrow.

The Sympathetic Nerves.

The physiological researches of Professor Bernard and others have led to the conclusion that the sympathetic nerves are motor nerves of blood-vessels—vaso-motor nerves,—and that they form a complementary organism, placed by the side of the cerebro-spinal axis, communicating with it, endowed with similar attributes, obedient to the same laws, but exerting their action on different tissues.

In 1851, Professor Bernard showed that a section of the cervical portion of the sympathetic nerve is always followed by a dilatation of the blood-vessels, and an increased afflux of blood in those parts of the head to which the sympathetic nerve is distributed. In 1852, Dr. Brown-Séquard demonstrated the converse,—namely, that either direct or reflex irritation of the sympathetic nerve by galvanism is followed by a contraction of the blood-vessels and a diminished afflux of blood. Again, in 1857, he showed the resemblance between the effects of a section of the sympathetic nerve in the neck, and a transverse section of a lateral half of the spinal cord. In both cases a paralysis of the vascular nerves, and therefore a paralysis of the blood-vessels, is induced. There is a greater afflux of blood in these vessels to which the divided nerves are distributed; nutrition is increased, and the vital properties of nerves, muscles, and blood-vessels are augmented. Many points of resemblance are

also found on comparing the side of the face where the sympathetic nerve has not been divided with the posterior limb of the uninjured side of the spinal cord. Both receive less blood than usual; in both the temperature is diminished, and the vital properties of both are decreased.

By the doctrine that the blood-vessels and secretory organs are dependent on the influence of the sympathetic nerves, many physiological and pathological phenomena which have hitherto been obscure admit of an explanation. Moreover, some experiments which Professor Wagner has lately made upon the head of an executed criminal tend to prove that the contraction and dilatation of the pupils are due to the influence of the sympathetic nerves. The head was cut off by the guillotine, the blade of which passed through the sixth cervical vertebra; and eighteen minutes after, the experiments were commenced. An electro-magnetic current was applied to the divided end of the great sympathetic trunk, first on one side of the neck, and then on the other. The eyelids of the corresponding eye were observed to separate, and the pupil to dilate, until the breadth of the iris did not exceed four-fifths of a line. The experiment was repeated six times in twenty-five minutes, and always with the same result. After the nervous trunks had become insensible, the superior cervical ganglion was laid bare; and similar results were again obtained on applying the magneto-electric current to it.*

* "Zeitschrift für Rational Medicin," 3^o Ser., Bd. 5, Nos. 2, 3. See also a paper "On the Influence of the Cervical Portion of the Sympathetic Nerve and Spinal Cord upon the Eye and its Appendages," by Dr. Ogle, "Medico-Chirurgical Transactions," vol. xli., 1858.

CHAPTER II.

PARALYSIS FROM AFFECTIONS OF THE SPINAL CORD.

THE elaborate mechanism for the transmutation of the impressions of sense into springs of action which the minute anatomy of the brain and spinal cord reveals to us, acquires a supplementary interest when we come to investigate it as the focus of morbid phenomena. We recognize its importance in the various degrees of arrest which are sometimes observed in its complete development; congenital defects which are seldom, if ever, compatible with the maintenance of life. We see it, too, in one of the earliest as well as in one of the latest diseases to which human beings are subject; and in both cases paralysis is generally the result.

Paralysis from Effusion and Compression of the Spinal Cord.

Hydrorachis, the consequence of a defective development of the vertebral arches, can appear as a congenital disease only; and although such arrest of genesis may not interfere with intra-uterine life and growth, it is in almost all cases fatal shortly after birth. Whether associated with hydrocephalus or not, it generally occasions paraplegia, which extends to the sphincters of the rectum and bladder, producing incontinence of fæces and urine.

This is not the place to dwell at length on the anatomy of tumours produced by hydrorachis, beyond the fact that they communicate with the cerebro-spinal fluid which is contained in the vertebral canal; that it is generally between the arachnoid and pia mater, which are not, in their healthy state, in such close apposition in the spine as they are within the skull; and

that the paralyzing influence is occasioned by the pressure of the fluid on the spinal cord.

On these considerations, various expedients have been suggested for the treatment of spina bifida; and in some few instances their practical application has had a successful result.

Desault recommended a seton to drain off the fluid; but in every case thus treated inflammation and constitutional irritation have terminated in death.

Abernethy suggested small and repeated punctures for the same purpose; and two successful cases so treated are recorded by Sir Astley Cooper, together with a graceful homage to the author of the proposition.* Considering spina bifida as a species of hernia, and that the deficiency of the spine might be compensated for by external pressure, Sir Astley also adopted a palliative mode of treatment which is attended with no risk, but which involves the necessity of mechanical pressure during the whole period of the life of the patient. The following is an instance:—

CASE 1.—James Applebee, an infant aged 1 month, whose head was not unusually large, the motions of its legs were perfect, and its stools and urine were discharged naturally, had a round and transparent tumour on the loins, of the size of a large walnut. A roller was applied around the child's waist to compress the tumour, and the pressure so exercised had no unpleasant influence on the voluntary powers; the stools and urine continued to be properly discharged, but the mother thought that the child was occasionally convulsed. At the end of a week, a piece of plaster of Paris, somewhat hollowed, and the hollow partly filled with a piece of lint, was placed upon the surface of the tumour; a strap of adhesive plaster was applied to prevent its changing its situation; and a rolled flannel was carried around the waist, to bind the plaster of Paris firmly upon the back, and to compress the tumour as much as the child could bear. This treatment was continued for about four months, during which period of time the tumour was examined three times a week; and the mother reported that the child was occasionally convulsed. When it was five months old, a truss was applied, similar in form to that used for umbilical hernia in children; and at the age of two years, the child could walk alone, talked, eventually went to school, and ran, jumped, and played about like other children. He passed well

* “Medico-Chirurgical Transactions,” vol. ii., p. 322.

through measles, smallpox, and whooping cough. He continued to wear the truss, by means of which the fluid was kept entirely within the channel of the spine ; but the tumour very soon acquired the size of half a small orange when the truss was removed.

CASE 2.—A boy named Little, aged 10 weeks, was taken to Sir Astley with a soft, elastic, and transparent tumour, as large as a billiard ball, situated on the loins. His legs were perfectly sensible, and his urine and fæces were under the power of the will. Finding that if the whole of the fluid contained in the tumour were pressed up into the spinal canal the pressure was too great upon the brain, Sir Astley punctured the tumour with a needle, and allowed two ounces of fluid to escape. Four days after, the tumour was as large as before ; and it was again punctured, when four ounces of fluid flowed out. At the end of four more days the tumour had regained its former size, and was again punctured, and a flannel roller was applied over it around the abdomen. The puncture was repeated after three days, when two ounces of fluid escaped. In three days' time, the operation being repeated, three ounces of fluid were discharged. Five days after, three more ounces were drained off ; but, instead of being clear, as at first, the fluid was sanious. Again, after four days, three ounces of fluid escaped ; after which a piece of pasteboard was placed within the rolls of the flannel over the tumour ; and on the repetition of the puncture, after four days more, three ounces flowing out, the pasteboard was again applied as before, and retained for ten days, when the surface of the tumour became inflamed, and the child suffered from constitutional irritation, for which a combination of calomel and scammony was given. The tumour, however, was punctured, and an ounce and a half of fluid, mixed with coagulable lymph, was discharged ; but the roller was discontinued for a time. On the following day, the tumour was not more than a quarter of its former size ; it felt solid ; the integuments were thickened ; and it had all the appearance of having undergone the adhesive inflammation. From this time forth the tumour gradually reduced in size, until eventually the skin hung flaccid from the basis of the sacrum, its centre being drawn to the spine, to which it united, so as to produce the appearance of a navel by the retraction of the skin.

A second case, treated in the same manner, terminated fatally, in consequence of constitutional irritation, convulsions being the principal symptom ; but the third was as successful as the first.

In neither of the above cases was there either hydrocephalus internus or paraplegia—complications which Sir Astley Cooper

considered as reasons for not attempting either method of treatment; but Rosetti has reported a case complicated with paraplegia which was cured, and the motions of the leg were restored, by repeated punctures and compression. The palsied state of the sphincter muscles, however, adds immeasurably to the danger and difficulty; for of all things it is most important to keep the tumour clean and dry, seeing that, under the most favourable circumstances, the tense skin is apt to become inflamed.

The treatment of spina bifida by iodine injections has lately been proposed to the profession, first by Velpeau; and in 1858, M. Debout, in a treatise on the "Therapeutics of Spina Bifida," gave the details of several cases in which iodine injections have been successfully used. In the following year, Dr. Brainard, of Chicago, recorded the particulars of ten cases treated by himself and other surgeons, of which four were successful. Again, in 1860, Dr. Gross, of Philadelphia, reported two cases in the "North American Medico-Chirurgical Review," one of which terminated successfully. In each case Dr. Gross punctured the tumour about an inch and a quarter from its base, by means of a small, flat, curved needle, which he directed subcutaneously into the sac. Then, through a small canula he allowed the escape of a drachm of fluid, and injected a solution of one-eighth of a grain of iodine, and a quarter of a grain of the iodide of potassium. He then closed the puncture by a twisted suture, and coated it over with collodion. Three drops of laudanum were given, and the child was kept lying on its face. Dr. Gross does not write encouragingly on the operation; still it must be admitted that the general results are favourable. In operating, the puncture should be very small, and the injection very weak at first; the object being to excite a slow process of inflammation in the cyst. It must be confessed, however, that if the life of the child be saved, paraplegia is apt to remain, together with involuntary defecation and micturition.

Paralysis from Congestion of the Spinal Cord.

Spinal congestion is in almost all cases a result of some specific form of disease; but, as Rokitsky has observed, it also comes on idiopathically.* “It then usually pervades the whole cord and its membranes, as well as the brain, and is most frequently met with in early childhood.”

In old people, the veins of the spinal cord which accompany the anterior and posterior spinal arteries are often found dilated and distended with blood. This in many instances may be hypostatic engorgement only; but cases also occur in which premonitory symptoms lead on to lesions of sensation and motion, which can only be attributed to a congested state of the spinal vessels, and perhaps to effusion into the vertebral canal.

CASE 3.—A gentleman, aged 76, consulted me in May, 1849, in consequence of a sense of heaviness and great weakness of the lower extremities, by which he had been inconvenienced for nearly six years, and for which he had taken a brisk purgative every second or third week with considerable relief. For a month or more, however, the left foot and leg had become somewhat numb and slightly cedematous; and he also experienced so much difficulty and pain in raising and rotating the thigh outward, that he had a room on the ground-floor converted into a bedroom. A series of blisters—one every fourth day—over the sacrum and loins, restored very much power to the lower extremities, and enabled him to use the psoas and iliacus muscles without pain. He had, moreover, a respite from any aggravation of the symptoms for some three or four months; still they recurred, but were always more or less relieved by counter-irritants and purgatives, until he died of bronchitis in 1860.

One marked symptom of which the subject of the above case invariably complained, was the great difficulty he experienced in walking on first arising after a night's rest: and this is generally a feature of spinal congestion. The faculty of motion is more liable to suffer than that of sensation, in consequence of the contiguity of the anterior columns of the cord with the posterior

* “Pathological Anatomy,” translated by Moore, vol. iii., p. 448.

surfaces of the unyielding bodies of the vertebræ; whilst the intervening loose cellular tissue between the posterior columns of the cord and the posterior arches of the spinal canal admits of venous congestion or extravasation of fluid without the same amount of injurious pressure.

CASE 4.—A locksmith, aged 20, during convalescence from gastric fever, the recovery from which appeared complete except that considerable weakness remained, was suddenly seized with paraplegia of the lower extremities, together with a tingling and pricking sensation, extending over the skin from the feet to the epigastrium; and an acute pain was complained of from the bottom of the back to the sixth dorsal vertebra. On the fourth day, a sloughing sore appeared on the sacrum, and the pain extended to the neck and arms, which were numb and very weak. The treatment consisted in the application of blisters; by degrees, the extremities regained their healthy power and sensation, and in less than a month the patient was discharged cured.*

It is, perhaps, impossible to determine the precise condition of the spinal cord and its vessels which may have occasioned the peculiar symptoms in the two preceding cases. Simple congestion of valveless veins at once suggests itself as a cause of the upward course of the morbid action which was manifested in both; but it is improbable that such a state would yield so readily to the influence of a counter-irritant, although it certainly does sometimes happen that the progress of an internal disease is arrested by a cutaneous eruption, and the veins of the spine communicate with the superficial veins, either directly or indirectly, throughout the whole extent of the vertebral column. Still, the venous sinuses, and the veins which accompany the anterior and posterior spinal arteries, diminish considerably in the sacral region; and it is scarcely probable that the functional lesion from congestion would first manifest itself where the veins are smallest.

If, however, the symptoms be attributed to effusion of serum, they admit of a satisfactory explanation, by the fact that the lowest part of the spinal canal is that to which the fluid naturally gravitates; and there the pia mater, the medium of nutrition

* “*Traité de la Moëlle Epinière et de ses Maladies*,” par C. P. Ollivier d’Angers, tome ii., p. 452 (deuxième édition).

to the nervous matter of the cord, would be first exposed to injurious pressure.

Irrespectively, however, of pressure from effusion, there is one circumstance connected with the peculiar mechanism of the vertebral column which is worthy of consideration in cases of spinal congestion, and it is this: that the spinal cord more completely fills the vertebral canal in the dorsal region than it does either above or below, and that, therefore, symptoms of compression of the dorsal portion of the cord may present themselves at a very early stage of the disease. But as this fact is, if possible, of still greater importance in relation to myelitis, I will again refer to it.

We may be too ready to attribute morbid phenomena of the nervous system to the influence of pressure from effusion, seeing that in the healthy condition the cerebro-spinal fluid serves as a support and protection to the spinal cord and nerves. In old age, too, there is a disposition in the cord to shrink, and the transudation of serum proceeds *pari passu* with the diminishing bulk of the organ. So far, therefore, it is a conservative action; but the increased mass of fluid must necessarily produce a sensible effect on the pia mater which surrounds a diminished cord; and it is just in this state of things that we are most likely to obtain relief by the local evacuating influence of blisters.

The ergot of rye has obtained great celebrity, and has been very much used in France within the last few years, in spinal congestion and in myelitis, in consequence of the property which it appears to possess of acting on the vaso-motor nerves, and thereby of diminishing the supply of blood to the spinal cord. I shall revert to this remedy in reference to the treatment of myelitis.

Paralysis from Meningitis of the Cord.

In meningitis of the spinal cord, paralysis does not occur, except from pressure produced by exudation of fluid, or by the extension of inflammation and disorganization of the cord itself.

M. Ollivier has given a very interesting example of spontaneous spinal meningitis, in which the symptoms accorded entirely

with the structural lesions observed after death.* In adducing instances strictly illustrative of the agreement between structure and function, I may be departing from the spirit of the age, which instigates to the investigation of anomalous cases; but, in truth, I have not made any exclusive selection to show that in the great majority of brain and spinal diseases, the symptoms point significantly to the seat of lesion.

CASE 5.—Gabriel François, a cook, aged 24, was admitted into the Hôtel-Dieu with obscure symptoms—a general *malaise*. On the fifth day of such discomfort, he was seized with paraplegia, together with hyperæsthesia of the lower extremities. Three days afterwards, the arms became partially paralyzed, semiflexed, and stiff; the right pupil was more dilated than the left; the association of ideas was slow. Two days subsequently he died. On *examination*, the cellular tissue which surrounds the dura mater of the spinal cord was enveloped in a layer of gelatinous yellow matter, between the arachnoid and pia mater. It was most abundant over the lumbar enlargement, and extended as high as the third cervical vertebra. It was thickest where it covered the posterior columns of the cord.

In more tractable cases, after the intensity of the inflammation is subdued by bloodletting, and other means calculated to overcome excited action, the paralyzing effusion may be drained off by the derivative effects of blisters.

Internal remedies, however, are not to be disregarded; and of these none promise to be more effective than the *secale cornutum* and the iodide of potassium. The external application of belladonna and chloroform will be found of great service in diminishing the violent pain which accompanies meningitis of the cord. Dr. Ramskill has reported two interesting cases of spinal meningitis, in one of which paraplegia supervened from rapid effusion of spinal fluid. In both, the iodide of potassium was used, and apparently with good effect; but in the case which manifested no complication of spinal effusion, the ergot of rye was employed in combination with the iodide of potassium.†

Paralysis may result from pressure occasioned by the deposit of cartilaginous or calcareous matter, from consecutive portions

* *Op. cit.*, tome ii., p. 551 et seq.

† “*Medical Times and Gazette*,” Aug. 31, 1863.

of fluid poured out during several mild attacks of spinal meningitis. According to Rokitansky,* this deposit is frequently found in the form of scales or laminæ on the inner or visceral surface of the arachnoid, giving rise to what is called ossification of the spinal arachnoid. It seldom happens, however, that the cord is actually compressed by this bony matter: consequently, irritation and affections of a convulsive character are the ordinary forms in which these adventitious growths manifest themselves.

Paralysis from Myelitis.

The lesions of sensation and motion which accompany inflammation of the spinal cord vary with the seat, intensity, and period of the disease. If only one side of the cord be affected, the paralysis which results is confined to the corresponding side of the body. When the anterior columns chiefly are the seat of inflammation, the paralysis which follows is that of muscular motion, but of sensation if the lesion exist in the posterior columns; and if a careful analysis be made of the several cases in which the grey substance of the cord has been implicated, it will be found that the function of reflex action has been deranged.

During the early stage of inflammation, when the capillaries of the cord are abnormally loaded with red blood, there is a corresponding exaltation of tactile sense and muscular contraction. It is true, death rarely occurs at this first stage of inflammation; but, if we may be guided by the analogy of corresponding conditions, superinduced towards the termination of disease of other portions of the nervous centre, the above inference is justified, and a case in point is recorded by M. Ollivier.†

But, as the corpuscles of the blood begin to be arrested in the injected vessels, a correlative diminution of the vital properties of the cord ensues; and it is made manifest by the decreasing sensibility or mobility of the parts which receive their nerves from the affected part. It is conceivable that the vascular dilatation, when thus carried to an extreme degree, produces injurious

* Op. cit., vol. iii., p. 440.

† "Traité de la Moëlle Epinière," vol. ii., pp. 636-640, Observation 81 (deuxième édition).

pressure on the complex organ, and thereby diminishes its functional activity.

The next stage is that of serous or purulent exudation, in which the consistence and cohesion of the nerve-fibres are destroyed, and a solution of their continuity takes place. The arrest and accumulation of the blood-corpuscles in the distended capillaries impair the quality of the blood, and cause it to behave in the same way as when separated from the living body. It coagulates, in fact, and the liquor sanguinis, together with red and white globules, transude through the delicate tissue of which the capillary walls are formed, and which is known to be favourable to the interchange between their fluid contents and the tissues through which they pass. In this way, as Mr. Lister has satisfactorily shown,* "these tissues in some degree approximate to the condition of dead matter, and cease to discharge the offices peculiar to them as components of the healthy animal frame." This disorganization entails a condition of complete paralysis, more or less extensive according to the seat and extent of the inflammation. Every part of the body which receives its nerves from the spinal cord below the upper level of the structural lesion is paralyzed: consequently, when destructive myelitis extends throughout the cord to the fifth pair of cervical nerves, the upper extremities are palsied, and all those parts which receive their nerve-power from a lower level of the cord are palsied too. If it reach still higher, respiration will be disturbed in consequence of the phrenic nerves becoming involved, whilst the circulation of the blood and the pupils of the eyes may be affected through the medium of the sympathetic nerves.

But if the paralyzing influence do not extend through the entire thickness of the cord, then may the lower extremities preserve their sensation and motion, although the arms hang powerless, owing to the disease having dissected out, as it were, the groups of ganglionic cells which determine the action of certain sets of muscles, whilst the conductors of the will for the movements of the legs pass by unscathed. An illustrative example, occurring in the practice of M. Broussais, is recorded by Ollivier.

* "Proceedings of the Royal Society," June, 1857.

CASE 6.—A medical student, aged 21, had sore-throat, a sense of suffocation, difficult deglutition, and embarrassed respiration. His pulse was full, hard, and quick; his skin hot and dry; and he had acute pain in the nape of the neck. In a very short time numbness of the fingers of the left hand came on, which, by degrees, extended up the fore-arm and arm; and, the following day, a pricking sensation was experienced over the whole limb, and difficulty also in moving it. The right hand and arm were quickly affected in a similar manner, whilst the symptoms in the throat and back of the neck continued unrelieved, notwithstanding forty leeches applied to the sides of the neck. In a short time both arms were completely paralyzed, but without any lesion, either of sensation or motion of the legs: the rectum and bladder, too, retained their healthy power. The febrile symptoms and dyspnoea gradually increased, and the patient died on the eighth day after the attack.

On inspecting the body, the corpora striata and optic thalami were found to be slightly tinged of a rose colour; as were also the pons Varolii and medulla oblongata, to a somewhat greater degree; the cerebellum being somewhat softer than the cerebrum. But in the vertebral canal the spinal sinuses were full of fluid black blood, especially in the cervical region, from which a pint at least escaped. Over the inferior and posterior half of the dura mater, covering the brachial enlargement of the cord, a mass of coagulated blood was found infiltrated into the cellular tissue between the membrane and the vertebral arches. On opening the dura mater, the lower portion of the meningeal canal contained a considerable quantity of red serum between the pia mater and arachnoid; and on the visceral surface of the latter, about the centre of the dorso-lumbar enlargement, four minute cartilaginous laminae were found; whilst over the brachial enlargement several points of adhesion existed between the opposed surfaces of the arachnoid. The brachial enlargement itself, for about the space of two inches, was remarkably soft, particularly the grey substance, which was red and pulpy. The corresponding part of the pia mater was thickened, red, and traversed by numerous vessels. The remaining portion of the cord below was somewhat soft, and the grey substance injected.*

This case is interesting on more accounts than one, for it illustrates most of the phenomena of myelitis in the cervical region of the cord. The next observation which Ollivier describes (No. 78) is demonstrative of the fact, that when destructive myelitis involves the entire thickness of the cord in the cervical

* Vol. ii., pp. 618—626, Observation 77.

region, there is, as might be expected, complete paralysis of the four extremities.

When the disease occurs in the dorsal region, between the two enlargements of the cord, the respiratory muscles which are under the influence of the dorsal spinal nerves, obeying the laws of irritability, are frequently agitated by violent spasms, and the breathing is accomplished by short and painful efforts. If the disease extend to either enlargement, the arms or legs may participate in the spasmodic movements. But as the work of disorganization goes on, anæsthesia of the surface and paralysis of the muscles, above alluded to, follow in the train of symptoms: abdominal respiration, disturbed circulation, embarrassed digestion, difficult defecation, inefficient micturition, and all the consequences of these respective functional disturbances, ensue.

CASE 7.—A nervous and imaginative man, with lateral curvature of the spine, is alluded to by Ollivier.* After an irregular course of life, he experienced, at the age of 34, considerable pain and numbness over the curved part between the shoulders; and complete muscular paralysis, with hyperæsthesia of the arms, rapidly ensued. Respiration and expectoration were difficult. He had likewise painful digestion, obstinate constipation, and considerable weakness in the expulsive power of the rectum; but he could void his urine, and retained the muscular power of the lower extremities, until he died, at the age of 44.

In this case, the spinal cord did not suffer from compression; but from below the fourth cervical vertebra to the fourth dorsal—about seven inches in extent—the cord was found to be little more than a diffuent mass of greyish-red fluid, which fluctuated about with the movements of the body. A few nerve-fibres remained in the situation of the anterior columns, but in the diseased part the anterior roots of the spinal nerves were reduced to their neurilemma only, all the white substance or nervous matter being absent: the posterior roots preserved their integrity.

The solution of continuity of the anterior columns was not complete; hence the case forcibly illustrates the independent function of each individual longitudinal nerve-fibre. And in considering the change of structure above alluded to, it should be remembered that no part of the animal body changes so rapidly

* Vol. ii., pp. 658—667.

after death as the nervous tissue; so that the decomposed state in which the diseased portion of the cord was found might have resulted from a *post-mortem* transformation: and that it was so, appeared from the injected condition of the capillary vessels which were left floating in the fluid mass—a degree of vascularity inconsistent with absolute destruction of both structure and function.

CASE 8.—Dr. Nairne has recorded a more acute case, in a boy aged 17, who had also an affection of the heart resulting from rheumatism, and in whom chorea existed. He was admitted into St. George's Hospital on the 27th of June, 1849; having been exposed on the 22nd to a severe jolting in a cart, on the following day he was unable to walk. On the 24th he was said to have had a fit. He complained of pain in his back, knees and feet, and had convulsive movements of his legs and the distortion of features of chorea. On the 28th, the convulsive disturbance was somewhat relieved; but on the 29th it again increased; and on the 30th it was so violent, that the sides of his legs and body became excoriated. During the last two days of his life, he passed his motions under him. On the 3rd of July he died; the convulsive movements having ceased only some hours before his death.

On examining the body twelve hours after, the spinal veins were found to be greatly congested; and a portion of the spinal marrow—an inch at least in length—opposite the third and fourth dorsal vertebræ was white, and reduced to a semi-fluid state. In the central part of this softened portion there was fluid; and the remainder was so thoroughly disorganized, that it was thought unnecessary to put any of it under a microscope.*

In these cases, convulsive movements are apt to occur in the legs, and to continue for a long time, even after the arms have become completely paralyzed. These phenomena are, doubtless, owing to the excitement of disease reflected from the spinal marrow to the motor nerves of the lower extremities. The same involuntary movements may be produced artificially by tickling the soles of the feet, the nervous connexion of which with the brain is cut off by the destruction of a portion of the cord. The influence of the stimulus is transmitted to the spine by the incident nerves, and is reflected back by the motor nerves, thereby producing spasmodic contractions of the limb. Some

* "Medico Chirurgical Transactions," vol. xxxiv., p. 37.

interesting cases of this description are recorded by Dr. Budd in the twenty-second volume of the “Medico-Chirurgical Transactions.”

But when the disease is confined to the lumbar enlargement of the spinal marrow, the convulsive movements occur at an early period of the disease, and cease *pari passu* with the disorganization of the cord. Dr. Brown-Séquard insists on the importance of this symptom for the determination of the precise seat of inflammation; the persistence of the spasms in the paralyzed legs being indicative of myelitis above the dorso-lumbar enlargement, and its early cessation a proof that the disease exists in the dorso-lumbar part of the cord. For a time, also, the electromuscular contractility is retained;* but eventually this latter property is almost always lost. In the same manner, if there be in the first stage spasmodic contraction of the sphincters of the rectum and bladder, the urine generally becomes alkaline from retention; and priapism not unfrequently results as a reflex action from a distended bladder: but this state soon gives place to a negative condition, which is often ushered in by reflex spasms of the legs during defecation and micturition.

The characteristic symptoms of paralysis, as induced by destructive myelitis, are—

1. Pain over that portion of the back which corresponds to the seat of inflammation.

2. Lesions of sensation giving rise to feelings of formication, creeping, pricking, tingling, heat, or cold; to numbness or complete anæsthesia.

3. A gradual and progressive diminution of muscular power, distinguishing it from the paralysis which the French have denominated *ataxie locomotrice progressive*.

4. An equable degree of paralysis in all the muscles which are implicated: for as in health the nerve-force is distributed to whole groups of muscles in an equal degree, so likewise is it annulled when the nervous centre is disorganized.

* To determine the amount of muscular excitability, M. Duchenne, of Boulogne, places the moistened conductors of his volta-faradaic apparatus on each side of the belly of a muscle, and thus ascertains the amount of electromuscular or Hallerian irritability which the muscle possesses.—“De l'Electrisation Localisée,” &c., p. 66.

5. Convulsive and reflex movements of the paralyzed muscles.

6. Spasm or paralysis of the rectum and bladder.

7. Alkaline urine. And, finally,

8. The loss of electro-muscular contractility.

Be the cause of acute myelitis what it may, whether accidental violence, inordinate muscular exertion, the abuse of venereal pleasure, cold, tubercle, or any other cause, when paralysis has once supervened, there is great reason to fear that the inflamed portion of the cord has passed into a state of disorganization, and that the disease is incurable. The prognosis, however, will in some degree depend on the precise seat of the disease. If it be in the cervical region, for reasons already stated, the immediate danger is greater than when in the dorsal. In this latter, again, the prognosis is more unfavourable than when the lower portion of the spinal marrow is affected; and when the patient retains the command over the motions of the rectum and bladder, and the acid character of the urine remains unchanged, the case is still more hopeful.

But in the dorsal portion of the spinal column there is an exceptional state of things, in consequence of the calibre of the canal, which is narrower and more closely adapted to the volume of its contents than any other part. In the cervical vertebræ, where the extent of motion between vertebra and vertebra is greater, the canal is of a triangular form, and large in proportion to the size of the cord. In the lumbar vertebræ it is also triangular and capacious, and the dura mater is loosely connected with the bony canal. A considerable space, moreover, is left between the opposed surfaces of the arachnoid, so as to allow of a sufficient play of one surface on the other; and thus, at the greatest extent of natural curve, no pressure can take place. Not so, however, with the dorsal vertebræ, the mechanism and articulation of which conspire to limit motion; and there the cord is closely enveloped in its membranes, which more completely fill the canal. This construction of the spine was first described by Mr. Earle* to explain a circumstance

* "On the Mechanism of the Spine."—"Philosophical Transactions," 1822, part ii., pp. 276—283.

which had been noticed in diseases affecting the vertebræ,—namely, “that the symptoms of irritation and inflammation of the spinal marrow are much more early manifested, and are generally more serious in their consequences when the dorsal vertebræ are affected than when either the cervical or lumbar are the seat of disease. In the former case, the slightest congestion or effusion is often productive of serious symptoms, from the canal being smaller and more completely filled with the marrow and its membranes; whilst in the latter description of cases, from the greater capacity of the canal and looseness of the membranes, considerable effusion may exist without at first producing any marked symptoms, more particularly in the lumbar region,”—where, from other circumstances already explained, pressure is less dangerous to life.

In all cases of paralysis dependent on myelitis, both diagnosis and prognosis are greatly assisted by a knowledge of every antecedent and concomitant circumstance connected with the particular instance. In the acute form, every characteristic sign is well marked, and the disease runs a rapid course. M. Ollivier gives, as an average, from three to four days;* but in some chronic cases the pain in the back is sometimes scarcely noticed, notwithstanding that the structural change in the cord may pass through every stage of disorganization. An example is quoted by Dr. Abercrombie from Professor Bréra:—

CASE 9.—A man, aged 40, was received into the hospital of Crema, in the spring of 1804, with no other complaint than general weakness and depression, for which no cause could be assigned. He lay constantly in bed, but did not complain of any pain; his appetite was good, and he was free from fever. From being lean and pale, he became so fat and ruddy, that suspicions were entertained that he was feigning: but, as winter approached, he became lean and cachectic. In February, 1805, he became completely paralytic both in his legs and arms, and he died suddenly in March. On *inspection*, all was sound in the head, the thorax, and the abdomen. In the spinal canal, however there was much effusion of bloody, sanious fluid, with

* An interesting case of paraplegia, from acute myelitis, which was caused by the action of cold in the body, and which lasted six days, is reported by Dr. Burrows in the “Medical Times and Gazette,” vol. xxii., p. 331. M. Ollivier records a case of chronic myelitis the duration of which was fifteen years.—Tome ii., Observation 92, p. 685.

marks of inflammation and suppuration in the spinal cord, the substance of which was remarkably soft, and tending to dissolution.*

Such cases, in which a progressive weakness is the only symptom antecedent to complete paralysis, are usually called non-inflammatory; and the morbid result is, for the most part, a white softening of the spinal cord: but ramollissement is very seldom observed where pain has not previously existed, and in the great majority of cases I am disposed to think that it depends on an inflammatory origin. Lallemand, of Montpellier, whose investigations were in a great degree confined to young and vigorous persons, regarded every case of softening as the result of hyperæmia, extravasation, and endogenous formation of pus; whilst Rostan, whose observations were confined almost exclusively to the aged, maintained that the structural lesion in question might occur without a trace of congestion, infiltration, or morbid secretion,—but that it resulted from a diseased state of the arteries, and, consequently, from an imperfect nutrition of the part to which those arteries are distributed.

It is probable that both views contain the elements of truth, and that softening may depend on inflammation, exudation, and alteration of the connective tissue of the cord; and that it may be produced also by a diseased condition of the arteries, and of the coats of the capillaries, whereby the mutual interchange between the blood and the tissues is interrupted.

Fortunately, the question is of no great practical importance; for, as a general rule of treatment, it may be stated, that as long as the affected muscles are convulsed, rigid, and irritable, the use of antiphlogistics and counter-irritants is indicated; but when the means which are calculated to subdue the stage of excitation have failed to arrest the further progress of disease, and paralysis supervenes, stimulants are the only remedies which have the power of restoring to functional activity those nerve-cells and conducting fibres which are not irretrievably destroyed.

And of all stimulants with which we are at present acquainted, electricity and strychnine are unquestionably the most potent

* “Abercrombie on the Brain,” &c., p. 354.

and the best. The latter appears to act as an excitant on the nerve molecules of the spinal cord, perhaps through the influence of the vaso-motor nerves : and if it does so, it is reasonable to suppose that it may do good after the exudative process has taken place.

M. Barbier, of Amiens, first suggested the *secale cornutum* as a remedy possessing the same power as that of strychnine, but in a more manageable form ; and M. Payan, of Aix, reasoning on the special action which the secale appears to have on the nervous system, producing as it does feelings of tingling and involuntary spasmodic movements of the legs, tried its effects in paraplegia, and in many cases with the most encouraging result. From repeated and careful observations, he concluded that where neither great pressure *beyond that which simple congestion produces*, nor disorganization of the spinal cord exists, its remedial power is very great. In one case of paraplegia, complicated with paralysis of the rectum and bladder, the healthy function of these latter organs was completely restored. At the Bicêtre, M. Guersant has had much experience of its action, and has established the fact of its efficacy as a means of resuscitating muscular contractility of the rectum and bladder, and of assisting the latter organ to expel the remains of calculus left after lithotomy.* The interesting question, however, which suggests itself from our knowledge of the property of ergot of rye in arresting uterine hæmorrhage is, whether its special agency may not be on the sympathetic system, and, consequently, on the vaso-motor nerves ? The gangrene which it produces points to that particular action ; and a distinguished physiologist affirms that he has seen the diminution in the calibre of blood-vessels of the pia mater of the spinal cord take place in dogs after they had taken large doses of ergot of rye, and that the reflex power of the spinal cord becomes very much diminished under its influence.† And yet the prolonged use of the ergot produces convulsive affections of the face and hands, and in some cases absolute opisthotonos—results entirely at variance with the growing opinion of the effects produced by a diminished supply of blood to the spinal marrow. But we are

* “Journal de Chimie Médicale,” June, 1839.

† “Lectures on the Diagnosis and Treatment of the Principal Forms of Paralysis of the Lower Extremities,” by C. E. Brown-Séquard, M.D., p. 73.

not called upon to discard a remedy because we cannot entirely explain its mode of operation ; neither should we disregard the experience of men like Guersant, Trousseau, and Brown-Séquard, from whom we have every encouragement to depend on the ergot of rye in chronic myelitis, especially when the pelvic viscera are implicated in the paralyzing influence. I have given the æthereal tincture in doses of from ten to twenty drops twice or three times a day, and certainly with advantage ; but I have not experienced the relief to reflex convulsions from it which I have been led to expect, and have, therefore, trusted to prussic acid, digitalis, and belladonna for that purpose.

After the local pain in the back has been subdued by the regular and repeated application of two or three leeches to the painful part, followed by a large warm poultice over the whole length of the spine, and a belladonna plaster of equal length to follow it, or an occasional blister on each side of the spine, together with mild, warm purgatives, if necessary, I have found no remedy so effectual as strychnia, in the dose of one-twentieth of a grain, repeated more or less frequently (twice or three times a day), according to the evidence of its action.

Electricity, after the activity of inflammation has been subdued, is a therapeutic agent of great value ; and my own experience has convinced me that the continuous current of galvanic electricity is just as efficacious as the induction or intermittent current.

Whether galvanism or electro-magnetism be employed, no high degree of tension is required for the restoration of muscular power : on the contrary, I suspect that the favourable course of many a case has been retarded by the employment of strong currents, and that Pflüger's experiments may be contemplated with advantage.

But when disorganization of the spinal cord has become an accomplished fact, the disease is incurable. The exigencies of the patient, however, are not the less pressing on the careful attention of the physician, and in nothing more so than the protection which is called for against bed-sores, which will sometimes occur in spite of the greatest care.

Spinal congestion and inflammation may result in apoplexy, or the formation of a blood-clot in the cord itself, or on its

surface; but paralysis is not an invariable attendant on such extravasation, unless it be in the substance of the cord. Such cases are extremely rare; but when they have occurred, the clot has generally been found in the cervical region, and, according to Rokitansky, in the grey substance of the cord. Dr. Abercrombie has given a summary of nine cases, in five of which the extravasation existed on the surface, and convulsions, without paralysis, were the principal symptoms. In four others, the cord being more or less implicated, paralysis ensued.

Paralysis may likewise supervene from induration of the spinal marrow, which is not an unfrequent result of chronic myelitis. The preternatural consistence is generally confined to the columns of the cord, and the cervical region is by far the most frequent seat of the affection. This structural change is probably due to a peculiar condition of the blood, or of the extravasated fluid from the blood, which becomes converted into an abnormal fibroid tissue, the deposition of which in the interstices of the longitudinal nerve-fibres involves the absorption of the nervous matter; and the resulting induration is called sclerosis. A very remarkable example of paralysis from this cause is recorded by M. Portal,* of which the following contains the most important details.

CASE 10.—The Marquis de Causan, of a nervous temperament, experienced some tingling sensation in the right hand, and shortly after in the right foot. This first symptom of nervous disturbance was followed by partial anæsthesia of the hand and foot; but the fingers and toes retained their healthy power of flexion and extension. Both hand and foot, however, wasted, and became colder than the corresponding members of the opposite side. Gradually the tingling and succeeding anæsthesia extended to the fore-arm and leg, and eventually advanced to the arm and thigh, each part wasting rapidly as it became affected. For about a year the disease remained stationary, during which the patient was enabled to walk about his room with the assistance of a crutch. Then the fingers and toes of the left side became similarly affected, and the symptoms of disease extended precisely in the same manner as they have been described on the right side. Eventually the patient was confined to his bed, unable to move either hand or foot. (By this we may infer that he gradually

* "Cours d'Anatomie Médicale," tome iv., pp. 116, 117.

lost the power of motion, as well as of sensation.) He breathed, and swallowed his food, however, without difficulty, and all the other functions of the body were performed. His sense of sight next became weak, and by degrees he became perfectly blind. The sense of hearing was lost in the same manner. Still, he could pronounce his words, but somewhat indistinctly, and the power of deglutition, by slow degrees, became more and more implicated, until he experienced great difficulty in swallowing a few spoonfuls of soup or jelly. The pulse, slow from the beginning, became slower and slower, until at last ten pulsations only in the minute were counted; and the respiration also became more feeble and more embarrassed, until at last life ebbed out. The body was examined by M. Dejean, a distinguished surgeon of the day, who found the brain and every other part healthy, except the spinal cord, the cervical portion of which was indurated to the consistence of cartilage. The membranes covering the disease were very red.

The above, together with two other cases of induration of the spinal marrow, are contained in M. Ollivier's work; and in all there is a great analogy of symptoms: but the most remarkable feature in all is the long duration of the disease, notwithstanding the important portion of the nervous centre affected. In neither case was there any muscular contraction which is so commonly observed in myelitis ending in ramollissement.

A remarkable case of induration and local softening of the spinal cord is also recorded by M. Laboulbène, which has been quoted as suggestive of the exact channel in the cord through which impressions of sensation are transmitted.

CASE 11.—Etienne Casse, aged 44, a carpenter, was admitted into La Charité, March 15, 1854, with his arms hanging paralyzed by his side. As long ago as 1843, after an excess of work and late hours, he lost his appetite; and, after a time, he felt fatigue more than was his wont: then he had pain in his loins and difficult micturition. At one time he had retention of urine; still he worked at his trade, but was troubled with the pain in the loins, cramps in the legs, loss of sleep, and tingling in the soles of his feet, his arms remaining unaffected. In 1849, he entered a *maison de santé*, in consequence of head ache, loss of memory, pain and sense of compression round the body, difficult micturition, and obstinate constipation. In August of that year, he felt a little weakness of the right hand and arm, so that he could not hammer a nail: his memory again failed him; but it

returned during the years 1851 and 1852, his right arm remaining weak. In the summer of 1853 it regained strength ; but in October it again became weak : his memory again failed, and in December the left arm also lost power. The pain in his back had disappeared. In 1854, the arms became powerless ; but he had prickling sensations in them, and cramps. He had still the use of his legs ; but they eventually lost power, and he remained in bed six months stiff as a statue. Then came a remarkable improvement, so that he was able to get up and walk ; but his arms remained powerless : and thus he presented himself at the hospital. By the use of moxas to the back, an induction current of electricity to the arms and hands, and by a course of iodide of potassium, he improved so that he could lift and carry a chair ; but the arms became cedematous, and the urine slightly albuminous. On the 16th June, he left the hospital much improved, but returned on the 16th of October as bad as ever, and with a recurrence of pain in the back ; and on the 3rd of November, after a day of agony, he died.

EXAMINATION.—Rigor mortis was very pronounced ; the brain was healthy ; the white columns of the spinal cord were indurated throughout, and shining, especially where cut into, except between the third and sixth dorsal vertebræ, where the cord was soft, pultaceous, and slightly red. In the indurated parts, numerous granules of greyish matter glued the nerve-tubes together and compressed them, their contents being homogeneous and viscous. The capillaries were few in number, and with granules on their parietes. In the softened portion, the capillaries were more numerous ; much granular matter existed ; as also in the cornua of the grey matter, but not in the centre.*

The iodide of potassium is a remedy which suggests itself to the mind in cases where there is good evidence to believe in the existence of chronic myelitis with induration of the cord. For upwards of ten years I had under my observation a gentleman, who, at the age of about sixty-five, began to show symptoms of what I suspected to be induration of the spinal cord. At an early period of the disease he had paroxysms of distressing formication, each of which was the prelude to loss of muscular power. A course of the iodide of potassium always relieved the itching and tingling surface, but on no occasion did it arrest the progress of the general paralysis.

* “Mémoires de la Société de Biologie,” 1855, pp. 233—45.

The absence of pain and of spasmodic muscular contraction of muscles in this affection, enjoins much caution in determining the precise moment when the spinal cord is likely to be favourably affected by the energetic excitement which strychnine has the property of communicating to it: therefore, its internal administration may be preceded by its external use, together with other stimulants in the form of embrocations over the spine, in this as in all other varieties of myelitis when the stage of excitation has been subdued. The same external applications may be employed for the purpose of stimulating paralyzed muscles to action through the influence of the sensitive branches of the spinal nerves.

Paralysis from Tabes Dorsalis.

A more tractable form of paralysis is not unfrequently seen in youth and early manhood, which may be traced to the vicious and enervating habit of masturbation. The exhausting practice is far more common than is generally supposed; but it is only when carried to an extreme degree that it entails a wasting of the spinal cord, and all the accompanying misery which have long been known under the designation of Tabes Dorsalis.

The terrible delineations made by Tissot, in his treatise on Onanism, are doubtless exaggerated for the purpose of deterring the unwary: and it is a pity they are so, for some imaginative minds are apt to be lured away by the romance of an erotic martyrdom, whilst a more faithful picture might inspire a protecting intimidation.

M. Lallemand, in the course of fourteen years, collected upwards of a hundred and fifty cases, in which all forms of specific diseases—of the brain, the heart, the lungs, the stomach, and of every other organ—presented themselves; every one of which was occasioned by diurnal pollutions.*

The propensity has been known to exist in early childhood, long before the testes and vesiculæ seminales had acquired their functional activity, or the moral attributes their restraining influence. But in such cases the habit has been engendered by

* “Des Pertes Séminalles Involontaires,” par M. Lallemand.

some local irritation of the sexual organs, such as ascarides in the rectum, incontinence of urine, accumulation of sebaceous matter between the glans penis and the prepuce, &c.

CASE 12.—A boy, aged 8, who had been the subject of paraplegia for several months, was placed under the care of M. Lallemand. The child's legs were kept in a bent position ; his face was pale, his body emaciated, and his intellect manifestly affected. Masturbation was the obvious cause of the infirmity, and the patient's hands were accordingly secured until inflammation of the urethra was set up by the introduction and retention of an elastic gum bougie for that purpose. By such expedient, the penis could not be touched without extreme pain. In eight days the boy was able to stand, and in three weeks from the commencement of the treatment he could run about as well as ever, no medicine having been given.

The restoration of the intellect requires far more time than is necessary for the apparent renewal of bodily vigour ; and it is when the mental faculties should be most rapidly expanding, that they are most apt to be blighted by the pernicious influence in question. From the age of twelve or fourteen, to eighteen or twenty, youths are not unfrequently exposed to a focus of contagion in schools and colleges, which masters and tutors, under the illusion of the innocence of their pupils, may repudiate, but which, nevertheless, exists ; and the evidence to the fact is the painful avowal which is readily made by the victims to the temptation. We have, moreover, the testimony of M. Lallemand, that “nothing is more common than timid, yet educated individuals, who complain of debility, and seek advice for the acquisition of strength, and who, when questioned, admit that they have been guilty of masturbation at an early age.”

CASE 13.—A collegian, aged 22, experienced, on getting out of bed, a sensation of tingling and numbness of the feet and legs, which went off after walking two or three times across his chamber ; and he felt no more of it for about a month. His legs, however, were weak ; and a month after the first attack, when at a ball, he discovered that he was perfectly unable to dance, having entirely lost the power to sustain the weight of the body, and preserve its equilibrium on either leg. He became perceptibly weaker daily, and on applying to me he could not ascribe his infirmity to any cause ; but when I alluded to that

under consideration, he immediately acknowledged the possibility, and on discontinuing it he soon regained strength, so that he played at cricket three months after without fatigue.

CASE 14.—Another collegian, aged 20, consulted me in consequence of a considerable failing of muscular power in his arms and legs, together with tingling and numbness in the arms and hands. Both deglutition and articulation were performed with difficulty, and he had strabismus with double vision. He could scarcely stand, and, in attempting to walk, threw his legs hither and thither to preserve his equilibrium: he had also a sensation of treading upon a soft carpet when on the bare floor. Defecation was somewhat difficult, but the power of micturition was preserved. For an entire month, during which he was taking the twentieth of a grain of the bichloride of mercury twice a day, the weakness of the legs increased rapidly, so that at last he could not stand without being supported by two persons, and the power of projecting one foot before the other was well-nigh lost. Up to this time he attributed the symptoms to a fall on the back which he had had some months before; and although no local pain existed in the back, counter-irritants had been applied. On questioning him, he at once allowed that he had practised onanism for some considerable time, and determined to break it off. The bichloride of mercury was discontinued, and the compound tincture of bark (ʒij.) twice a day was taken instead. The expulsive power of the rectum was regained in a few days, and at the end of two months the gentleman could walk a mile. An occasional small blister to the back appeared to give an impetus to the recovery of strength on every occasion that such appliance was used.

Many circumstances occurred in the above case which are observed in the disease, lately named by the French, *ataxie locomotrice progressive*. Both are apt to originate from onanism, and it is possible that spermatorrhœa may have existed in the affection just described, but the attention of the profession had not been directed to that enervating phenomenon. The peculiar movements of the legs, the partial anæsthesia and diplopia, are all symptoms which characterize ataxia; and it is probable that if atrophy of the spinal cord had been realized in my patient, the successive stages of ataxia would have been observed in him, with this marked difference, however—that in the case I have recorded, the muscles of the extremities absolutely lost their power; whereas, in ataxia, it is the loss of the power of co-ordination in the acts of volition, and not the loss of

muscular power, which is observed. This distinction has been strongly insisted on by M. Trousseau as a pathognomonic sign.*

The habit to which the occurrence of tabes dorsalis has been imputed is not peculiar to the male sex. It is sometimes, though much less frequently, practised by the female also, in whom the brain yields more rapidly to its influence. I have seen but one unequivocal case: and in that I was led to think that that peculiar morbid state of the spinal cord which engenders a host of affections, united under the common name of spinal irritation, was the exciting cause; for, on pressure being made over the lumbar vertebræ, a sensation of intense throbbing and itching was aroused, which provoked the necessity of friction.

The observation of M. Deslandes,† that out of every twenty cases of leucorrhœa in young females, from fifteen to eighteen result from masturbation, will not, I am sure, be endorsed by medical practitioners in this country. On the Continent, and especially in the southern portions of it, sexual abuses are undoubtedly carried on to a frightful extent; and there, M. Deslandes' statement may be founded on facts.

Two cases are recorded by Lallemand‡ in which there was a change of anæsthesia from one hand to the other almost daily, and this kind of transference from one part to another is not unusual in tabescent palsy.

Tabes dorsalis has been known to produce affections of every organ of the body: consequently, the disease is remarkable for the diversity of its symptoms, which vary according to the constitution of the patient. And although its early influence may engender functional disturbance only, the permanent irritation reflected from the spinal cord is adequate to the establishment of structural lesion in any of the viscera.

On the other hand it should be borne in mind, that there is not an organ in the body which may not be the source of a reflex palsy: so that it becomes a matter of great importance to determine correctly the order of antecedence, lest we render ourselves obnoxious to the rebuke which is implied in Lallemand's avowal, that he has seen many cases of tabes treated for spinal

* "Clinique Médicale de l'Hôtel-Dieu de Paris."

† "Dictionnaire de Médecine," art. Masturbation.

‡ Vol. iii., p. 65.

irritation, by leeches, cauteries and blisters, with more harm than good.

The pallid face, the eye encircled by a livid areola, the furtive glance, the muscular debility and emaciated frame, form, collectively, a reason for suspecting the existence of onanism : and when paralysis supervenes, in nineteen cases out of twenty the patient will readily admit the truth of the conjecture.

The *prognosis*, in these cases, must obviously vary according to the indications of the extent of atrophy of the spinal cord. If the paralysis be not occasioned by absolute degeneration of the cord, muscular motion may be restored, debility may sooner or later disappear, and the wasted muscles may regain their healthy volume. Such was the happy result of the three cases I have described : but I suspect the generative power is never thoroughly developed in those individuals who have practised masturbation to a great extent in their youth, or restored to a vigorous condition after it has been lost, from that cause, in manhood, even when the wasting of the spinal marrow has not proceeded to any considerable extent. But when the lumbar portion of the cord is reduced, as it sometimes is, to less than half its natural size, and its structure is considerably indurated, the paralysis is incurable : for the amount of diminution is not an expression of the precise quantity of nervous matter absorbed, seeing that there is in *tabes dorsalis*, as in induration from chronic myelitis, a deposit of adventitious, fibroid, connective tissue, which compresses, and still further atrophies the contracted nerve-cells and nerve-fibres.

The *treatment* of tabescent palsy should be influenced by the cause from which it originates. If any local irritant exist, it should be removed ; and in the administration of tonics, it is advisable to refrain from such as have the property of stimulating the generative organs. Accordingly, when the rectum is fretted by the presence of ascarides, an excellent tonic, anthelmintic, proposed by Dr. A. T. Thomson, is a solution of ehloride of sodium in a strong sulphureous water. A drachm of common salt, in half a pint of Harrogate water, taken early every morning, and an enema of the same administered every night, will effectually expel the worms in conjunction with the superabundant mucus.

If irritating sebaceous mucus be the cause of irritation, and the prepuce be long, Lallemand has found circumcision to be the best remedy ; and Mr. Athol Johnson endorses the recommendation by the record of a case in which onanism was practised to a very injurious extent by a boy six years old. The sense of hearing was considerably impaired, and Mr. Johnson, after trying many remedies in vain, removed a portion of the prepuce with benefit.* So also in the female, should the pernicious habit be carried to the extent of endangering the intellect, the most promising remedy is excision of the clitoris.

In no bodily disturbance is the value of pain more manifest than in these cases of sclerosis of the spinal cord, wherein it is rendered conspicuous by its absence. In all other inflammatory conditions of the organ, local pain and muscular contractions are inestimable indications of treatment ; and in tabes they would be a warning for the administration of the ergot of rye, iodide of potassium, and belladonna, at the precise period of time when irritation, congestion, and infiltration might, possibly, be arrested.

The patient is fortunate who seeks and follows the physician's advice in time to be rescued from the consequences of absolute disorganization of the spinal marrow : and in such a case, the main indication of treatment is to restore muscular tone, and to subdue nervous susceptibility. This object is best attained by a mild, unstimulating nourishment, by gentle tonics, and by protecting the patient, as far as it is possible, from salacious thoughts and feelings.

In many instances, the mere relinquishment of the enervating habit allows the natural elasticity of the constitution to regain bodily tone ; but when the nervous centres and flagging muscles require the assistance of medicine, the unstimulating preparations of iron, combined, if necessary, with camphor or conium, are the best that can be given. The daily or occasional use of the bath, either tepid or cold, and in such a form as is found to promote the greatest amount of comfort and reaction, is a valuable remedy. The French give considerable faith to the sulphureous waters of Cauterets, Bagnères de Luchon, and Aix in Savoy.

* "Lancet," April 7, 1860.

Galvanism, by means of a weak continuous current, may be employed with advantage for the purpose of restoring activity to the paralyzed muscles. If the attempt be made through the influence of the sensitive branches of the spinal nerves, the current should be directed from the part moved by the palsied muscles to the spinal cord; but if the muscles are to be stimulated by the direct action of the galvanic current, it should be made centrifugally from the spinal cord to the muscles themselves. Both plans may be adopted, and Pulvermacher's galvanic band is, perhaps, the most convenient instrument to use.

After restoring to the several organs which may be implicated in the disorder their harmonious action, if debility of the genital organs be found to remain, such aphrodisiacs as the chlorate of potash, dilute phosphoric acid, and brucia may be given; but it should be carefully borne in mind that temporary stimulants are worse than useless; and in the category of this class of medicines, cantharides stand prominently forth as the active principle in the so-called Italian lozenges and Venetian pastilles, as well as in those nostrums which are daily advertised in our public journals.

Paralysis from Morbid Growths in and about the Spinal Cord.

These adventitious products occur under various forms, and give rise to a diversity of symptoms, from which we may calculate upon more assistance in determining the functions of each individual portion of the spinal marrow than from any direct experiments, however carefully they may be conducted.

Of all extraneous growths from which paralysis ensues, the most frequent are tubercle and cancer. Neither, however, has been so often observed in the vertebral canal as in the cavity of the cranium: but when either occurs, the slow process of its formation may enable the cord so far to accommodate itself to exceptional pressure or structural disintegration, that the function of the special part which is the seat of lesion is more clearly manifested by its gradual disturbance than by any abrupt change induced by artificial means. The sudden shock

and extension of irritation to surrounding parts necessarily weaken the force of any inference that may be drawn from the result of an experiment.

Tubercle of the cord occurs more frequently in children than in adults, and its attendant symptoms are those of compression and irritation.

CASE 15.—Philippe Oran, aged 29, was admitted into the Hospital St. Antoine, under Dr. Aran, with paraplegia, rigidity of the inferior extremities, anæsthesia of the legs and thighs, and eneuresis. He was insensible to tickling on the soles of the feet, but reflex movements were produced thereby. This patient had practised onanism in his youth, and subsequently committed great excesses in venery. He had also been affected several times with syphilis. Percussion on the spine produced considerable pain over the upper third of the dorsal region. He had paroxysms of shivering and fever, and behind the trochanters bed-sores existed. Notwithstanding that the soles of the feet were insensible to tickling, pricking of the skin over the instep was felt acutely.

On *examination* of the body thirty-five hours after death, a mass of tubercular matter was found to have burst out of the vertebral canal, and to occupy a space over the fourth dorsal vertebra: but the greater part of the morbid product was contained in the canal where it pressed upon the cord, which was flattened and softened to the consistence of cream. The osseous lesion existed in the bodies of the third and fourth dorsal vertebræ.*

The relation of the above case is not so explicit as we might desire; but I think we may reasonably infer that the partial anæsthesia was the consequence of pressure on the posterior columns of the spinal cord, which were found flattened and soft. The persistence of reflex phenomena, however, and the sensibility to pricking on the instep, would indicate that the impressions of the afferent nerves continued to be transmitted to the cerebral grey matter of the cord.

An interesting case of paraplegia depending on a tumour in the substance of the cord is described by Mr. M'Dowell, Professor of Anatomy in the University of Dublin.†

* "Comptes Rendus de la Société de Biologie," 1856, p. 191.

† "Dublin Quarterly Journal of Medicine," November, 1861.

CASE 16.—The patient was a tin-plate worker, John Neal, aged 24, thin and delicate-looking. He was admitted into the Whitworth Hospital January 31, 1861, complaining of great debility, difficulty in standing, and of a sense of constriction round the waist. He had had syphilis. About a week after admission he experienced some difficulty in passing his water, which was alkaline and fetid. On the night of February 11th, he had a shivering fit, and walked more feebly, and with a staggering gait, the day after. By the 16th the paraplegia was complete: he could not support the weight of his body on his legs; the sensibility of the surface was somewhat diminished; he had frequent desire to pass urine, which was ammoniacal. Two days later (18th), in addition to the entire loss of all voluntary motion in the lower extremities, the excito-motory phenomena were much diminished, the sensibility of the surface of the legs considerably impaired, the bowels obstinately constipated, and micturition very difficult; but no stricture existed. On the 20th, he was seized with vomiting, cold perspirations, and an intermitting pulse, when softening of the spinal cord was diagnosed. On the 24th, a bed-sore appeared, in spite of every means taken to prevent it. From the 1st to the 15th February, however, he rallied, although bad ulcers were formed over the sacrum. He regained, in some slight degree, the power of moving his left foot and leg. The foot could be bent and extended, and the leg could be drawn up in bed; the right foot and leg remained utterly powerless; but in the right foot and leg the reflex movements regained well-nigh their normal activity, whilst in the left it was impossible to excite them. Sensibility was equally impaired in both legs, and did not reappear. In the right leg voluntary motion was extinct, but reflex motions were excited; in the left reflex motions were extinct, but some power of voluntary motion remained. On the 15th March, the sloughing of the soft parts was reported as being shocking; some branches of the gluteal arteries were exposed, which bled freely when the bed-sores were dressed. Nevertheless, the patient lingered on until the 2nd of April, when he died.

EXAMINATION SIXTEEN HOURS AFTER DEATH.—The spinal cord was carefully removed from the vertebral canal, its membranes were perfectly healthy, and nothing unusual was observed on the surface of the cord; but to the touch its dorsal portion was sensibly diminished in consistence. On making a vertical section of the cord, a remarkable alteration was observed. In the grey matter of the dorsal portion, but occupying chiefly the right side, a tumour existed, of a firm consistence and yellow colour, globular in form, about the size of a large pea, perfectly smooth both on the surface and in section, and of a fibro-glutinous structure. Both above and below this tumour the

cord was somewhat softened, and in parts preternaturally vascular. In the centre of one area of vascularity a small yellow spot was observed, a miniature of the larger deposit, but no trace of tubercle was found in any part of the body. The brain was healthy, and the bladder thick.

The difference in the amount of paralysis may be accounted for by the position of the tumour in the right side of the grey substance, where the vesicular portion of the nervous matter possessing the faculty of originating motive power is situated. But how shall we explain the loss of excito-motory phenomena on the left side, unless they depend on the decussating fibres which pass from the anterior cornu on the one side into the anterior column on the other? The author of the history of the case has accounted for it by the supposition that reflex motor phenomena are better developed when the influence of the brain is cut off from the spinal cord; but the cases are so numerous in which the reflex phenomena are entirely destroyed when the influence of the brain is entirely cut off—at least, after a time—that I am more disposed to regard the disappearance of the phenomena as dependent on a solution of continuity at some point between the afferent and efferent nerves. That volition does exercise a restraining influence there can be no doubt; but the reflex function is not dependent on the abrogation of such influence.

The most unequivocal case that I remember to have read of, as showing that the posterior columns of the cord are not the sole channels for the transmission of the impressions of sensation, but that the grey substance is equally subservient to the function, is related by Ollivier.*

CASE 17.—J. Mancel, a shoemaker, aged 54, of a weak constitution, lymphatic temperament and small stature, was seized at the age of seven with hip-joint disease, which was cured by ankylosis. In the year 1821, he became somewhat suddenly insensible, and paralyzed of the inferior extremities. The paraplegia was well-nigh complete when he entered the St. Louis Hospital. After perfect repose and twenty-four vapour baths, the power of motion so far returned that he could walk with a crutch.

* “*Traité de la Moëlle Epinière*,” tome ii., p. 779, Observation 111. See also p. 693.

At the end of the year 1823, together with sharp pains in the lumbar region, a tumour appeared on the left side of the back, on a level with the inferior angle of the left scapula. The tumour and pains gradually increased: the patient also experienced a distressing sensation in the loins. Under such circumstances, he was admitted into the Hôtel-Dieu the 2nd February, 1824. He was generally emaciated. The tumour presented an oblong, soft, elastic character, without any discolouration of the skin covering it; slightly painful; and the left arm was benumbed. He complained of the pains in the loins, of dull sensations in the legs, but was able to walk with the assistance of a stick. The functions generally were healthy. On the 9th, M. Dupuytren made six stripes along the entire length of the back with the actual cautery; and on the 14th the pain in the loins and numbness of the arm were diminished in intensity. After some time the tumour appeared to diminish, but the patient became weaker and obstinately constipated, the rectum having lost its expulsive power. There was slight fever with colicky pains every evening, which were temporarily relieved by a dose of castor-oil.

The weakness of the legs increased, and they were also affected with convulsive movements: the constipation, too, became more stubborn, and difficult micturition supervened, a few drops only of urine passing after considerable effort. The loss of sensation was complete in the inferior extremities, but a slight power of motion remained; the temperature was felt to be diminished in the legs, although it did not appear to be so to the touch. The legs became completely powerless to sustain the weight of the body; and the paralysis of the bladder made it necessary to keep a catheter introduced. The actual cautery was again employed, and for a few days the sensibility and feeling of warmth were restored to the legs; but the convulsive movements became more frequent, and no improvement appeared in voluntary motion. At length gangrenous bed-sores supervened; the constipation became so absolute that it was necessary to extract the fecal matter from the bowel: and, last stage of all, the contents of the bowels flowed out involuntarily, the weakness increased, and the patient died in the full possession of his intellect.

EXAMINATION.—Brain healthy; in the lumbar region, behind the bodies of the vertebræ, small, whitish, cheesy-looking laminæ were observed on the external surface of the dura mater, which were easily removed by a scalpel; and on the posterior aspect of the dura mater similar laminæ existed. On cutting the pia mater, at the level of the articulation between the last dorsal and first lumbar vertebræ, in the substance of the cord, an olivary tubercle, from eight to ten lines long, eight thick and six wide, gave to the spinal cord an appearance

of preternatural thickness. The medullary substance surrounding it appeared healthy, neither too soft nor too hard; no sensible vascularity; and underneath the tubercle the spinal marrow terminated as it does in the healthy condition; the roots of all the nerves appearing to be perfectly healthy. The tubercle was hard, composed of indurated tubercular matter, and was apparently lodged in the very centre of the cord, equidistant between the anterior and posterior surfaces. The spinal column and the vertebral canal presented nothing abnormal.

The sensation of numbness in the left arm was probably due to pressure on the cutaneous nerves (the nerves of Wrisberg) which proceed from the upper dorsal nerves, in the neighbourhood of the tumour, on the left side of the back. The convulsive movements and other symptoms of irritation may be referred to the morbid action, evidence of which existed on the surface of the dura mater, whilst the loss of sensation and motion was caused by pressure exercised on the vesicular nervous matter, and the longitudinal tubular fibres of the grey substance, in which pressure the longitudinal white columns of the cord must have eventually participated. It has been remarked that in paraplegia dependent on tumours in the grey substance of the cord, anæsthesia sets in at the very beginning of the affection, and proceeds to a greater degree than the loss of the power of motion. Another remarkable feature in such cases is the exaltation of the reflex function in the parts of the cord below the tumour, probably from the irritation occasioned by the adventitious matter; a condition of things in which it is reasonable to suppose that a very slight provocation would produce the most violent reflex movements.

All this is in strict accordance with the anatomical structure of the parts; and if more evidence be required to the theory which assigns to the longitudinal nerve-fibres in the grey substance of the spinal cord the transmission of impressions of sensation, and of the mandates of the will, it is beautifully supplied by cases in which the grey substance has been destroyed. An instance of this kind has lately been recorded by Dr. Gull.*

CASE 18.—The patient, a journeyman tailor, was admitted into the clinical ward of Guy's Hospital February 5, 1862, having for

* "Guy's Hospital Reports," vol. viii., 3rd series, p. 245.

eleven months been unable to extend the little and ring fingers of the right hand, during which time he felt the disabled parts cold and numb. Then the adjoining finger began to be affected in the same way, and it was thirteen months after the first symptoms appeared that he presented himself at the hospital. Some seven weeks before, he had pains shooting through the chest, and a sense of tightness across the upper part of it. Next (four weeks after) the three inner fingers of the left hand became similarly flexed, but without any numbness. He had never received any injury to his back. When admitted, he was pale, but complained only of wasting and weakness of the hands. He had no pain in them: the right was cold and numb; the left was not so cold, and retained its sensibility. He could move both thumbs and the index fingers freely: he could also extend the first phalanges of the other fingers. His arms moved freely in all directions. Pressure over the fourth dorsal spine produced a sharp, pricking pain, as of a knife being thrust into it; but when not touched he had no pain. The sphincter muscles retained their healthy tone, the urine was normal, the appetite and digestion good.

The wasted muscles were daily galvanized by an interrupted current, and a fortnight after admission he had gained power in his hands, and felt sensibly strengthened after each application of galvanism. It was observed that, with a moderate current, the contractility of the palsied muscles of both hands was good. The patient sickened, however, with typhus fever, and died on the 8th of March.

EXAMINATION.—All the organs were healthy except the spinal cord, in the centre of which a large cavity existed, beginning at the fifth cervical vertebra, enlarging downward to the seventh, and from thence tapering to the fourth dorsal. The only remaining portion of grey matter was at the anterior part of the cavity, behind the anterior column. The columns themselves were healthy. Where the grey matter remained, the caudate cells were normal in size and structure. The cavity in the cord was bounded by a layer of condensed grey substance, like a distinct lining membrane, on the interior surface of which were a number of delicate nuclear bodies like epithelium cells. The cavity was filled with a fluid. The roots of the nerves were healthy.

It is worthy of observation, that there is no notice of any paralysis of the inferior extremities; whence we may infer that none of the longitudinal nerve-fibres in the grey substance extend throughout the entire length of the cord. And in another case, described by Ollivier,* remarkably analogous to the above,

* Vol. ii., p. 691, Observation 93.

the disorganization of the grey matter appears to have taken place in a downward direction, the symptoms presenting a corresponding extension.

CASE 19.—A trunkmaker, aged 38, experienced, in 1818, without any assignable cause, a sensation of numbness and coldness in the index finger of the left hand; next, in the entire hand and arm. Soon after, the same symptoms manifested themselves in the right hand and arm. In the course of the following year the lower extremities became similarly affected; and eventually the four limbs were completely paralyzed. When the patient was admitted in the Bicêtre, in January 1826, he presented the following condition:—

The inferior extremities painfully contracted; the legs bent on the thighs, and the thighs on the pelvis; when touched or struck, the contraction of the legs was increased; sensibility still remained, but it was dull. The two arms were in a state of strong adduction, approaching each other in front of the thorax; all the fingers bent on the palms of the hands. The only movement the arms were capable of was one of entirety from the shoulders. The sensibility, as in the legs, was very obtuse. The features of the face preserved their natural appearance, the tongue was not affected in the least degree, speech was perfect, and the intellectual faculties perfectly preserved.

All the nutritive functions remained intact, and nothing appeared to threaten life, when suddenly a large bed-sore formed on the sacrum, which was soon followed by accelerated pulse, diarrhœa, prostration of strength, and death.

EXAMINATION.—The brain and its investing membranes healthy. From the lower part of the corpora pyramidalia to the inferior extremity of the spinal cord, and in its very centre, a tubular canal was found, filled with a greyish mucosity. The walls of the canal were formed by the surrounding white columns, the grey substance having disappeared. All that remained of the spinal marrow were four isolated cords, two on each side, the anterior and posterior columns.

Portal also relates the case of a servant of the Duc de Crouy, who was seized with numbness of the arms and legs, which subsequently lost all power of motion and became œdematous. On examination after death, a large quantity of fluid was found extravasated in the ventricles of the brain; and a large cavity was discovered in the centre of the spinal cord, extending down to the third dorsal vertebra.

A somewhat similar case is related by Velpeau, in the "*Revue Médicale*" for 1826, of a woman aged 56, who gradually, but

rapidly, became affected with complete hemiplegia of the *left* arm and leg, but without loss of feeling. The left arm became œdematous. Her respiration was quick, her voice weak, and her speech somewhat embarrassed. The pulse became feeble, the breathing stertorous, and in a week she died. In the middle of the cervical region, the grey substance on the *right* side of the cord was converted into matter resembling pus. An abscess, in fact, existed three inches long and three lines in diameter. On the left side also, and in the corresponding portion of the cord, the grey substance was found in a state of *ramollissement*, about an inch in extent.

Upon pathological cases, then, as well as upon anatomical structure and experimental observations,* it would appear that the central grey substance of the cord, independent of the vesicular matter which it contains, includes nerve-fibres which are directly or indirectly concerned in motion and sensation. But, upon anatomical grounds alone, there is great reason to infer that it is with the excito-motory or reflex actions that the grey substance is so concerned: for as in the lower extremities the reflex actions are more evident than they are in the upper, so the bulk of the grey substance is much greater in the lumbar region than it is in the cervical; and yet the ordinary sensibility of the legs is less acute than that of the arms. Case 19 would have presented an excellent opportunity of observing how far the reflex function was destroyed by the disorganization of the central portion of the cord; but, beyond the remark that the contraction of the legs was increased when touched at the time the patient was admitted into the Bicêtre, the narrative conveys no information on this interesting question. Case 16 is more suggestive, because it is more circumstantially described.

That paralysis may ensue from *cancerous formations* in and about the spinal cord, too many cases have been recorded to admit of the slightest doubt. Still, cancer in the cord is a very rare form of disease, and, like tubercle, is one of a secondary development, other organs being more obnoxious to such morbid growths. The symptoms, too, resemble in so many respects those which present themselves in tubercle of the cord, that the

* "Course of Lectures on the Physiology and Pathology of the Central Nervous System," by C. E. Brown-Séquard, M.D., F.R.S.; Lecture 4th.

diagnosis is dependent rather on the general diathesis of the patient than on any special signs. The vertebræ themselves may be the seat of the disease, as shown by Dr. Walshe* in a case where, "with the progress of the cancerous infiltration, the bony tissue of the body of a lumbar vertebra had disappeared, and the adventitious substance, reaching the anterior and posterior limits of the cancellated structure, destroyed the compact tissue also, and protruded posteriorly under the dura mater into the spinal canal, and anteriorly under the anterior ligament. It had subsequently grown in front of the spine in an upward and downward direction, so as to reach the bodies of the vertebræ, next above and next below."

A remarkable case, published by M. Velpeau,† in 1825, to illustrate Sir Charles Bell's doctrine, has still its interest as regards the relationship existing between the seat of disease and disturbance of function.

CASE 20.—Madame Martin, aged 36, of a nervous temperament, had an illness, which was regarded as nervous, when she was 27 years old ; but from that period of her life she had good health until she was 34. Then she had great trouble, and, depending on her needle, was obliged to work through a great part of the night. She lived in a low, damp situation, and often felt the cold air over her loins. First some convulsive movements came on, but soon ceased. Shortly after a sharp pain fell in the left arm, which was relieved, but not subdued, by opiates : headache, however, supervened, and the menstrual function ceased. The pains in the arm returned, and the movement of that extremity became gradually affected : the convulsive affection also recurred, and extended to the lower extremities ; and complete paralysis ensued.

On her admission into St. Come, she was in the following condition :—Her face was calm, and her intellectual faculties perfect. She did not complain of anything in particular, and suffered but very little from the left arm, which she could not move ; but its sensibility remained undiminished. The motions of the right arm, though difficult, were still accomplished. In this right arm sharp pains occurred, but nowhere else throughout the body. She had little appetite either for food or drink ; her tongue was slightly red ; the respiration feeble, but unembarrassed ; the pulse quick, sometimes strong, but generally small and regular. A large, deep bed-sore existed over the sacrum ;

* "The Nature and Treatment of Cancer," by W. H. Walshe, M.D., p. 525.

† "Archives Générales de Médecine," Janvier 1825, tome vii., pp. 68—82.

the legs were œdematous ; the lower half of the thorax, and all the organs below subject to the influence of the will, had completely lost the faculty of sensation and of motion. Yet the patient often complained of irradiations producing a feeling of icy coldness in the abdomen. She was unconscious of the passage of the fæcal matter from the bowel, or of the water from the bladder. The power of moving the right arm was insensibly lost, but she continued to have pain in it until three days before she died. When that arm was pinched or pricked, great pain was produced, but the left arm became almost insensible. In spite of all remedies, the poor woman became weaker and weaker ; a little febrile action was set up, her speech waxed gradually weaker, her eyes more dim, and, after remaining two months and a half in the hospital, she died without agitation, and almost without pain.

EXAMINATION.—With the exception of infiltration of serum in the legs, the exterior of the body presented nothing remarkable. The brain throughout was healthy, and the first appearance of the spinal cord indicated a healthy state of that organ also ; but, on opening the dura mater, on the spinal arachnoid a large quantity of small cartilaginous laminae existed over three-fourths of its inferior portion. It was at first thought that they were particles of soap which had been suspended in the water used to wash the parts ; but it was not so, and they were developed on the visceral surface of the arachnoid. The cord itself appeared healthy,—a little firmer, perhaps, than natural, throughout its entire length. All the posterior roots of the nerves were distinct and presented no alteration, and nothing remarkable appeared on cutting into the cord here and there. But on taking it from the vertebral canal, a morbid growth existed, covering the anterior portion from the sixth pair of cervical nerves to the third pair of dorsal.

The colour of this adventitious production was reddish yellow or rusty, and occupied the space between the arachnoid and the cord, with which latter it was intimately united, and on which it had exercised considerable pressure. Between the natural tissue of the spinal marrow and the morbid mass there appeared to be a continuity of substance. The tumour was flattened and thicker on the left side than on the right. It seemed to grow from the left anterior column, and there the anterior roots of the nerves could not be distinguished. The posterior were still distinct, but pushed towards the right side. The spinal cord was completely flattened by the fungoid mass, particularly on the left side. The nature of the morbid growth resembled encephaloid. Behind, as well as above and below the tumour, the spinal cord was healthy. It was probably a real cancerous growth, and of a primary character, too, for no other organ was affected.

In this case the adventitious matter in the interior of the cord must have so completely destroyed the healthy structure through which it ramified—a process which connective tissue is specially prone to undergo,—that the continuity of the complicated links which have been shown to exist between the nerve-fibres were as effectually severed as if they had been divided by a knife.

But in the process, the convulsive movements and pain in the left arm were, doubtless, due to the irritation set up in the corresponding side of the spinal cord, and transmitted by the motor and sensory nerves backward to the arm; and in this stage of the disease hyperæsthesia of the arm existed, just as the irritation caused by a section of the lateral and posterior columns of the spinal cord produces hyperæsthesia: * but, as the destructive influence of the cancerous infiltration progressed, and the vesicular matter of the grey substance of the cord was destroyed, motion, sensation, and the excito-motory actions were destroyed with it. It is probable that the persistent sensibility of the right arm was due to the fifth cervical nerve, which sends a branch to the brachial plexus: for if the least quantity of the central grey matter of the cord had been left, the reflection of irritation from one sensory nerve to another sensory nerve would not entirely have ceased, as it did in every nervous branch below the tumour. The extraordinary part of the case was the sudden supervention of paraplegia: for in affections of the spinal cord, where the morbid change is of a chronic nature, the paralytic effects are less abrupt than in injuries or acute disease.

These physiological remarks find a place where some notice should appear in respect of prognosis and treatment. Is it necessary, however, to confess that these cases are incurable?

Hydatid cysts have likewise been known to produce fatal paralysis. Five such cases are recorded by Ollivier; and, curiously enough, all occurred in females. In the cellular membrane on the external surface of the vertebral column was the primary seat of the parasitic growth, whence it spread in the track of the nerves, through the intervertebral foramen, to the external surface of the dura mater. One of these cases, which

* Dr. B.-Séguard. pp. 19—21.

fell under the observation of M. Chaussier, is so interesting that I will venture to transcribe it :—

CASE 21.—An embroiderer, aged 22, at the commencement of the ninth month of her second pregnancy, had been attacked some few weeks before with paralysis of sensation and motion in her lower extremities. As neither œdema nor emaciation existed, it was presumed that the paraplegia depended upon some compression on the origin of the lumbar or sacral nerves : but, on a careful examination of the pelvis and spine, nothing abnormal could be detected ; the patient, moreover, never having had a fall, blow, or previous indisposition, the diagnosis was in some degree confirmed. The abdomen was of the ordinary size for the circumstances of the case ; there was no local tenderness or swelling ; the pulse was good, the respiration unembarrassed, speech unaffected : in short, all the functions were healthily performed, and the patient preserved every appearance of health, except that from the commencement of her pregnancy, being naturally lively and gay, she became gloomy, morose, and irascible ; that towards the third month, she had experienced, at the upper part of her back and on the right side, a dull, continuous pain, which was aggravated by coughing, laughing, or sneezing ; that sometimes the pain was accompanied with oppression and difficulty of breathing ; and that occasionally the same pain recurred up to the time of her admission into the Maternité Hospice, although less severely. Occasionally, shudderings would come over her, and a sense of numbness of the right arm, which did not render the limb useless ; but the neck was inclined backward, towards the right side ; and it was so stiff, that to see anything on one side the patient was obliged to turn the whole body.

Towards the sixth month, scintillations, quivering, and even convulsive movements of the right eye, occurred ; and the lid was paralyzed so that it could not be raised. But these symptoms disappeared.

At the seventh month, after a little bleeding from the arm, with the view of relieving the numbness, sensation and motion were suddenly lost in the right thigh, and soon after in the left ; so that the poor woman, who had previously been able to get up, was obliged to remain in bed, or to be carried. Micturition and defecation also became more difficult and less frequent.

This assemblage of symptoms pointed to some one part of the spinal cord as being the seat of compression and irritation ; but as the precise part could not be determined, the pregnancy being in an advanced stage, and all other functions of the body being duly performed, such palliatives as existing circumstances called for were employed, with the hope that time would furnish more unequivocal indications of

treatment. In the mean time, the symptoms remained unchanged ; the patient was cheerful, she ate with enjoyment, she slept well, and passed her days on her bed embroidering muslin.

On the 4th June, 1807, parturition was suddenly accomplished without pain ; the cries of the child and the rapid diminution of bulk being the only evidence by which the woman was assured of the fact.

The few first days following delivery were passed satisfactorily. Milk was duly secreted, and the mother began to nurse her child. Occasionally, however, she experienced shooting pains, and disagreeable startings of the lower extremities, particularly of the right leg.

On the evening of the fourth day, without any antecedent shivering, an attack of fever supervened, and was followed by a copious perspiration from the head. From that time the pulse was contracted and quick, the surface hot, the tongue dry and white, the lochia suppressed, the secretion of milk diminished ; defecation became frequent and involuntary, as was also the discharge of urine. Still, the abdomen was soft and free from tenderness, but the respiration was short and embarrassed. With a desire to cough, there was inability to effect it. In addition to all, gangrenous spots appeared on the sacrum and buttocks.

From day to day the symptoms assumed a more aggravated form. At intervals, a sense of oppression and suffocation, together with frequent cough, without any expectoration, disturbed the patient ; the nights were restless, the bed-sores enlarged, prostration increased, and on the tenth day after giving birth to her child she died.

On examining the body, the investing membranes of the brain were found to be injected with blood, and a transudation of serum to exist on the surface and in the ventricles. The pericardium and pleura also contained effused serum. The brain and heart were healthy ; but the posterior part of the upper lobe of the right lung was compact, and formed part of an ovoid cyst which had formed on the right side of the bodies of the third and fourth dorsal vertebræ. This cyst contained a great number of hydatids of various sizes. The two vertebræ were superficially eroded, as were also the heads of the two ribs connected with them. Between the third and fourth rib a large, deep excavation was found, which extended to the base of the spinous process, and into the mass of muscle between the spinous and transverse processes of the vertebræ. From thence it communicated by the fourth intervertebral foramen, which was largely dilated, with the vertebral canal. On opening the latter, a dozen or more of these acephalo cysts, packed together, extended as high up as the first dorsal vertebra, where they embraced the external surface of the dura mater

like a ring. At this point the membrane was thickened, its colour was red, its capillary vessels engorged, and it formed a kind of collar which compressed the spinal cord. Although the consistence of the spinal marrow was not sensibly affected, it was observed that all the spinal nerves given off below the strictured part were manifestly firmer and smaller than those which were given off above : and the great splanchnic nerve, too, was indurated and small.

Here again we may associate each and every symptom, in the order of its appearance, with the probable development of the acephalo-cystic formation. The first sensation of numbness in the right arm was, doubtless, attributable to pressure on the nerves of Wrisberg, or eutaneous nerves of the arm (the anterior branches of the second and third dorsal nerves), as were the subsequent disturbances of the right eye, and of the vascular system to pressure and irritation of the right sympathetic nerve. I have already had occasion to allude to the influence of the sympathetic on the motions of the eye ; and its vaso-motor power is now generally admitted. M. Colin, however, has shown that its sensibility is more effectively aroused by pressure than by any other means ;* and Dr. Augustus Waller has pointed out the fact that pressure on the trunk of the nerve gives rise to embarrassed respiration and disturbance of the heart's action†—symptoms which occurred in the course of the case in question.

It will be observed that up to the seventh month of pregnancy no symptom existed which might not have been caused by pressure on nervous trunks outside the vertebral canal ; but the supervention of paraplegia attested the existence of a lesion of the spinal cord itself ; and the question is, of what special part ? Was it compression of the external white columns, or of the internal grey substance, to which the paralyzing influence was due ? The gradual penetration and intrusion of the cyst seems to favour the idea that it was the former : for, as the pressure was at no time so great as to produce disorganization of the cord, it is reasonable to presume that the longitudinal columns suffered more than the grey substance.

Another interesting phenomenon was the painless yet effective

* "Comptes Rendus, Mai 13, 1861," p. 369.

† "Proceedings of the Royal Society for 1861," No. 44, p. 382.

contraction of the uterus ; and herein some light is thrown by the observations of M. Brachet which render it probable that absolute destruction of the spinal cord is necessary for the perfect inertia of the uterus.* Hence it would appear that in paraplegia from simple compression of the cord, the sensibility of the uterus may be suspended or destroyed whilst its contractile energy remains undisturbed. And this contractility appears to be of a reflex character ; for it may be excited by the application of cold to the surface of the abdomen, by the introduction of the hand, or even by placing the child at the breast.

Whilst, therefore, I am disposed to think that from pressure on the white columns of the cord the nervous communication between the brain and uterus was cut off, it appears that an independent reflex action was preserved in the comparatively uninjured portion of the cord, and that to this latter operation the expulsion of the fœtus and the subsequent startings of the legs were due.

Paralysis from Dislocations and Fractures of the Vertebrae.

The functional disturbance of the spinal cord which attends almost all cases of dislocations and fractures of the vertebrae imparts an interest to such particular injuries which the same accidents to other bones do not possess.

The shortness of the vertebrae, the intricate manner in which they are interlocked, the large surfaces by which their bodies are connected, and the small amount of motion admitted between any two of them, render it almost impossible that either dislocation or fracture can occur without considerable violence and mischief being done to the spinal marrow ; and yet we do occasionally hear of fractured spines without paralysis : but they are exceptional cases.

Paralysis of every part of the body which is supplied with nerves proceeding from the spine below the seat of injury is the all-important symptom, and in almost every case it will be found that retention of urine and difficult defecation exist also. The former of these symptoms, however, is not dependent on a

* “Fonctions du Système Nerveux Ganglionaire.”

palsied state of the muscular fibres which surround the bladder, for that organ empties itself perfectly when a catheter is introduced. The detrusor urinæ is a voluntary muscle, and its loss of power would in some degree account for the difficult micturition; and it is chiefly to the loss of voluntary relaxation of muscles which surround the urethra and the rectum to which the symptoms in question are due. Like all other voluntary muscles of the body, they are under the influence of the spinal cord; and, as we have seen in most of the cases thus far recorded, retention of the excretions results from a severe injury or division of the cord. Incontinence of urine is a common symptom when disease of the cord comes on gradually. It implies either irritation of the cord or of the bladder; in which latter case it is simply a reflex action, and, as such, appears when the sphincter muscles of the bladder and rectum have lost their contractility, shortly before death takes place.

CASE 22.—Henri, a mason, aged 49, fell backwards down stairs, whilst loaded with two sacks of plaster, one of which struck his breast, whilst his head rested on one of the stairs. He was stunned; but when admitted into the hospital, the lower extremities were not paralyzed. When seen in the evening, his head was continually bent forwards, and to the right side; and it could not be rotated towards the left. The spinous processes of the last two cervical vertebræ were very prominent; and above this there was a depression, which rendered it impracticable to feel the spines of the fourth and fifth. To the left of this depression there was another prominence, which, it was presumed, was produced by the transverse processes of these last-named vertebræ. There was at this time entire paralysis of the lower part of the body, and the respiration was purely phrenic. This patient died quietly ten hours after the accident.

When the body was examined, a dislocation of the fifth from the sixth cervical vertebra was found, the former being forced forwards; yet the bodies of neither were broken. The intervening fibro-cartilage was, of course, torn through; but the only fracture was that of the points of the transverse processes of the fourth and fifth vertebræ. The spinal marrow was torn through at the seat of dislocation.

CASE 23.—François Chazot, aged 41, of athletic frame, was at his occupation as a sawyer in the pit, when the plank which was being cut fell in, and struck him principally on the back of the neck. He

was taken up, being unable to move, and at once conveyed to the Hôtel-Dieu.

When visited, he was lying perfectly still, with his head inclined forwards. There were some slight bruises about the shoulders, and he complained of indistinct pains about the posterior cervical region; these were aggravated on pressure or movement of the head forwards. Every part below the breast was deprived of sensibility and power of motion, with the exception of the diaphragm, by which respiration was exclusively carried on. The pulse was full and strong, and the voice was natural, but could not be raised beyond the ordinary pitch of conversation. I ordered him to be bled, but very little blood could be obtained, probably from the want of muscular action to accelerate the flow through the veins. This patient sank quietly, and died at the expiration of twenty-four hours.

EXAMINATION.—There was a large ecchymosis at the back of the neck and behind the œsophagus. The body and articular processes of the fifth cervical vertebra were dislocated forwards from the sixth; and the upper margin of the latter was broken off towards its right side, the fractured portion adhering to the body of the fifth: the left inferior articular process of the same vertebra was also slightly fractured. The laminae of the sixth vertebra were broken through in a vertical direction, and driven in so as almost to obliterate the spinal canal at this point: the intervertebral and most of the ligaments were torn through at the same spot. The anterior spinal muscles, the vertebral arteries, and phrenic nerves were uninjured. The spinal cord was flattened, compressed, and softened.

The above two instances of dislocation, which I have copied from the “*Leçons Orales*” of Baron Dupuytren,* typify all dislocations at the lower part of the cervical region, and tend to illustrate the fact, as stated by that illustrious surgeon, that the cause of death is apparently “the upward extension of disorganization of the spinal cord, so that the origin of the phrenic nerves is ultimately involved, and death takes place from asphyxia.”

MM. Hamon and Mercier have related two cases of fractured sacrum, in each of which, together with partial paralysis of the lower extremities, there was retention of urine and fæces. So, also, in a patient of Dupuytren’s, who threw himself from a

* “On the Injuries and Diseases of Bones: being Selections from the Collected Edition of the Clinical Lectures of Baron Dupuytren.” Translated and Edited by F. Le Gros Clark, for the Sydenham Society.

third-story window. "There was deformity and abnormal mobility near the lumbar region. The paralysis did not at first extend above the lower part of the thighs, but the bladder and rectum were included. There was a temporary improvement, but soon the paralytic condition involved the whole of the lower limbs; an extensive slough formed on the sacrum, and the patient sank, preserving his intellectual faculties to the last. The spinal cord was found more voluminous than natural, especially at its lower part. Opposite the tenth dorsal vertebra was a cyst filled with pus, and formed in part by the medullary substance reduced to a fluid consistence. The body of the second lumbar vertebra was fractured."*

The subject of the following case, also described by Dupuytren,† gives us some idea of the time required for the restoration of nerve-fibre after it has suffered solution of continuity:—

CASE 24.—Charles Millié, aged 21, carman, was admitted into the Hôtel-Dieu, in 1825, with paralysis of the bladder and extremities, caused by a fall on the back of the neck. The paralytic condition was more marked on the left side than on the right, and in the lower than in the upper extremities. After two months and a half of entire rest, combined with bloodletting from the arm, as well as by cupping and leeches, he was convalescent, and quitted the hospital with only slight weakness in the left leg, and the head a little bowed forwards.

In spite of injunctions to be very cautious in taking exercise, he undertook a long walk, and whilst out was attacked with paralysis: he fell down, and remained in the open air all night. When conveyed to the Hôtel-Dieu on the following day, the paralytic condition was much more complete than on the former occasion, involving the lower extremities, which were entirely powerless and insensible, and also the arms from the shoulders to the hands. At the lower part of the neck there existed a pain which extended to the left shoulder: neither bladder nor rectum acted.

The patient was bled twice, and the catheter was introduced. Some days afterwards he was affected with spasmodic contractions of the limbs and bladder, and the catheter was no longer required. A moxa was applied between the shoulders, but without benefit:

* "On the Injuries and Diseases of Bones: being Selections from the Collected Edition of the Clinical Lectures of Baron Dupuytren." Translated and Edited by F. Le Gros Clark, for the Sydenham Society, p. 365.

† Ibid., p. 358, 9.

the skin over the sacrum and trochanters began to slough ; diarrhœa set in ; and the patient sank exhausted, thirty-four days after the fall.

On examining the spine, a fracture through the lower part of the body of the fourth cervical vertebra was found : it extended obliquely downwards and forwards, but the parts were prevented from being displaced by the articular processes. The left transverse and articular processes of the fifth vertebra were fractured, so as to permit the fourth to slip forward and compress the cord at this point. The intervening fibro-cartilage between the fourth and fifth vertebræ had disappeared ; and along the line of fracture in front of their bodies was an osseous deposit resembling callus, which itself presented a fissure, as if consolidation had taken place ; but the parts had again yielded to violence.

Opposite the point of compression the cord exhibited an annular constriction, abrupt and well marked, and very analogous to that presented by the intestine in some cases of strangulated hernia. When incised longitudinally at this spot, the colour and consistence of the cord were found altered to a brownish hue, and to the density and firmness of fibrous tissue : a small circumscribed spot, about a line in extent, was especially characterized in this way. The membranes were also more adherent here than elsewhere. It was inferred that the seat of this peculiar change was that of the original lesion, and that the morbid appearance constituted a true cicatrix of the spinal marrow.

In another instance, the details of which are contained in the "*Rapport de la Société de Chirurgie*,"* about the same period of time was required for restoring the integrity of the spinal cord after an incised wound.

CASE 25.—A boy, aged 15, received a wound from a cutting instrument in the back, which penetrated between the tenth and eleventh dorsal vertebræ, and probably divided the right half of the spinal marrow. There was complete paralysis of motion, and incomplete loss of sensibility of the right thigh and leg. The patient made a good recovery, and at the end of two months was able to walk four or five miles. A remarkable symptom in this case, which has been often noticed before, was the quantity of cerebro-spinal fluid which escaped from the wound during the first twelve days after the receipt of the injury.

A somewhat similar though less successful case is reported by Herr Schwanderer, in which a punctured wound was inflicted in the spinal marrow between the second and third dorsal vertebræ. There

* "*L'Union Médicale*," p. 552 ; 1860.

was paralysis of the right foot and leg, shortness of breathing, and involuntary discharge of fæces and urine. The foot remained partially paralyzed.

The next case, which fell under the observation of Mr. Belcher, of Burton-on-Trent,* is interesting, not only as illustrative of fractured spine generally, but as an example of reflex action induced by the first shock given to the spinal marrow.

CASE 26.—W. W., a strong, muscular sawyer, aged 37, whilst in a state of intoxication, was thrown from a cart with a child in his arms. He fell forwards, with his vertex striking the ground, by which he was stunned, and, “like a corpse,” was lifted into the cart and carried home, a distance of about a mile.

When first seen by Mr. Belcher, his skin was pale, cold, and clammy; his heart's action very irregular and weak. He was quite sensible, and complained of intense pain from the occiput down between the shoulders to about the fourth dorsal vertebra. There was swelling to the same extent, and it was impossible to trace the spine clearly. Upon carefully raising him to undress him, he screamed out, and begged to have his chin supported; for if that dropped, he could not breathe. *He had an involuntary action of the bowels. There was priapism.* The legs were completely paralyzed as to motion, nor could reflex action be excited by tickling the soles of the feet. The abdomen moved to a small extent during respiration, but it seemed a passive movement; the abdominal walls were distended by the down-pressed viscera; and when this tension was taken off, they merely collapsed again. The lower ribs, corresponding to the insertion of the diaphragm, moved somewhat as in asthmatic breathing. Above this point the chest-walls were completely motionless. The arms retained the power of motion freely; but the fingers were paralyzed and flexed, and the movements of the wrist were extremely weak. The head and neck moved freely when supported by the pillow; but he could not lift his head. Sensation in the trunk and upper and lower extremities was greatly and evenly reduced, though not quite lost. He could just feel a sharp pinch, but could not distinguish two points of the compasses, however forcibly applied and however wide apart. He was carefully placed in bed, supported by pillows and sand-bags, and ordered perfect rest on his back.

The following day, the symptoms of collapse and drunkenness were

* “British Medical Journal,” Nov. 22, 1862, pp. 531, 2.

gone: pulse 70, jerking, but regular. The heart's action was weak, the impulse abrupt; respiration unembarrassed, but phrenic. He had passed no urine. Upon passing the hand firmly up and down the spine, a crepitus was felt over the first and second dorsal vertebræ. In the afternoon of the same day he had a severe struggle for breath, caused by an accumulation of mucus. The heart's action was irregular; the tongue furred and dry; intense aching in both arms; numbness and tingling all over. A pint and a half of strong, high-coloured acid urine was drawn off by catheter.

On the fourth day, the priapism disappeared. Catheterism was employed daily every eight or ten hours; and in consequence of the urine being acid, very bloody and strong, the bladder was washed out with tepid water. The bowels were also constipated.

On the seventh day, the urine became alkaline, and continued to be bloody. The bladder was washed out with acidulated tepid water, after which he had a comfortable night; but he gradually became weaker, sometimes struggling for breath,—probably in consequence of accumulated mucus, which he had not the power to cough up.* On the fifteenth day he died easily, after several exhausting paroxysms of attempted cough.

EXAMINATION TWENTY HOURS AFTER DEATH.—The vertebral column was exposed from the third cervical to the fifth dorsal vertebra. There was considerable ecchymosis and staining of the muscles and tendinous structures in the cervico-dorsal region. The spinous process of the first dorsal vertebra was splintered, and a small portion detached. The ligaments were ruptured. The articular processes of the first and second dorsal vertebræ were fractured, and their capsular ligaments torn. The arches of these vertebræ were separated to some extent. The ligamenta subflava, torn and ragged, were adherent to the superior vertebra; and the spinal canal was opened from behind. There was no dislocation nor fracture of the bodies of the vertebræ. There was a small fibrinous clot in the intravertebral canal—probably the remains of extravasation. The theca was torn almost completely across as to its posterior surface, a very small portion remaining entire. It was collapsed, and at first sight entirely empty; but upon carefully slitting it up, it was seen to contain a thin layer of a whitish-brown matter, of the consistence of thick cream. This diffused state of the cord was continued upwards from the rent about a quarter of an inch, and downwards about an inch, the rent being about opposite

* It is worthy of notice that in cases of paralysis dependent on injuries at the inferior portion of the cervical region, the power of inspiration is preserved, but the power of expiration, as for coughing and raising the voice, is lost.

the broken articular processes. Above and below this space the cord appeared of healthy consistence, but somewhat red and hyperæmic. The theca itself, above and below the rent, was vascular, but otherwise healthy.

Considering the small amount of displacement of the fractured bones, it is very probable, as Mr. Belcher suggested, that the lesion of the cord was considerably increased by the amount of motion to which the patient's head was exposed immediately after his fall; and if so, the case has the adventitious interest of illustrating the danger of attempting the reduction of dislocated vertebræ.

In all these accidents, there is so definite a correspondence between the extent of paralysis and the seat of the injury, that the diagnosis is seldom difficult; and, with the additional evidence afforded by the deformity, the abnormal mobility, the crepitus, and the absence of cerebral symptoms, the nature and measure of the mischief may be determined with tolerable certainty. It should be remembered, however, that concussion of the spine, without either dislocation or fracture, has been known to produce paralysis. A very curious case of this kind is recorded by Dr. Reynolds,* in which paraplegia came on six months after a fall on the right shoulder from a load of hay. The accident caused great pain, which continued until the paralysis supervened; and three days after, the pain ceased. There was an entire absence of any other symptoms of nervous disturbance—no lesion of sensation—but the paraplegia assumed an intermittent form, and eventually disappeared under the influence of strychnia. Dupuytren has described some cases of diseased cervical ligaments which have led able practitioners into error.†

But when either dislocation or fracture of the first or second cervical vertebra involves the phrenic nerve in the lesion which destroys the function of the other nerves which associate the muscles of the chest in the act of respiration, there is no time given for diagnosis. In the cases just described, a patient may drag on a painful existence for a time; but when

* "Lancet," December, 13, 1863.

† Op. cit., pp. 346—349.

such an injury is inflicted on the cord at the base of the medulla oblongata, death is the immediate result. Two instances of this are recorded by Sir Charles Bell.*

CASE 27.—A man was trundling a wheelbarrow in Goodge-street, near the Middlesex Hospital : in going from the carriage-way to the flag-stones, he met the impediment of the curb-stone. He made several efforts to overcome it, and at length, drawing back the wheelbarrow, he made a push and succeeded ; but the wheel running forward, he fell, and remained motionless. He was taken into the hospital, but he was found to be quite dead. The tooth-like process of the second vertebra of the neck had burst from the transverse ligament of the first. The impulse given to the head had done this violence, and had, at the same time, carried forward the spinal marrow against the process, and on which it was crushed.

CASE 28.—A young man was brought into the Middlesex Hospital who had fallen upon his head. He soon recovered, and lay for some time in the hospital without exhibiting a symptom to raise alarm. He had given thanks to the assembled governors of the hospital, and had returned into the ward for his bundle, when, on turning round to bid adieu to the other patients, he fell, and in the instant expired. Upon examining his head, it was found that the margins of the occipital hole had been broken : no doubt, it had happened that in turning his head the pieces were displaced, and closed and crushed the medulla oblongata as it passed from the skull.

In both cases, the injury of the medulla oblongata arrested the act of respiration on the instant of its occurrence.

Not only is the attempt to reduce either dislocation or fracture inexpedient, but it is positively dangerous ; for the force required to effect the desired object would necessarily implicate the spinal cord in the extension, and intensify the mischief which compression may have set up. Therefore, with whatever reluctance we may feel, yet must we regard these injuries as incurable and mortal.

If, however, as sometimes happens from gun-shot wounds, the spinous process only of a vertebra be fractured, the mischief is not very serious. I remember to have seen a case in which

* “Of the Nerves which associate the Muscles of the Chest in the Actions of Breathing, Speaking, and Expression.”—Philosophical Transactions, 1822; p. 302.

the spinous process and the posterior portion of the arch of one of the lower cervical vertebræ was shot away, so that the theca of the cord was exposed. The subject of the accident was an officer, who received the wound in the Crimean war. When he arrived in England, the external wound had healed; but pressure over the part produced numbness and a sense of heaviness of the arms. By wearing a metallic shield over the part, he suffered no great inconvenience.

Perfect quiet, on the back, is the best remedy in all fractures and dislocations of the vertebral column; but great care is necessary to protect the paralyzed and insensible surface from bed-sores. Active treatment may be necessary to subdue local inflammation; and if much flatulent distension of the abdomen exist, a warm purgative enema may be given. If requisite, the urine must be drawn off by a catheter. In cases of diseased ligaments of the spine, issues are of great service.

It will be observed that I have endeavoured to illustrate the relationship between the symptoms of disease and the anatomical structure of the parts on which those symptoms depend. This course, I venture to think, is more useful than the search after rare and exceptional cases, in which, supposing the post-mortem examinations to have been perfectly conducted, we are compelled to admit the marvellous and inexplicable nature of the disease.

The most extraordinary that I remember to have read of is contained in the "*Journal de Chirurgie*."* The subject, J. P. Ripert, aged 21, was admitted into the Hôtel-Dieu, on the 10th of August, 1792, in consequence of a gun-shot wound just below the inferior angle of the scapula, and which had occasioned effusion into both sides of the thorax. He survived the wound twenty-six hours, during which no other symptoms than those of effusion manifested themselves. He voided his urine freely, had no paralysis of the inferior extremities, but, on the contrary, continued to move them in an agitated manner until he died.

On tracing the course of the ball after death, it was seen to have penetrated the chest between the eighth and ninth ribs,

* Tome iv., p. 137; 1792.

to have traversed the inferior lobe of the right lung, thence through the right side of the body of the tenth dorsal vertebra into the vertebral canal, where it had entirely divided the spinal marrow. From the spinal canal, it passed into the left cavity of the thorax, which, like the right, was found full of blood, and carried out with it a portion of the inferior lobe of the left lung, between the seventh and eighth ribs near their angles.

Two cases are reported in the "*Archives générales de Médecine.*"* The subject of one was a soldier, who had received a sword-thrust through the posterior part of the twelfth dorsal vertebra, between the spinous and oblique processes. The wound passed through the spinal cord, the point of the sword extending to the right side of the eleventh dorsal vertebra, whence it was extracted after death. Yet the man marched eighty leagues after the infliction of the wound: and Velpeau vouches for the accuracy of the details of the case.

The other was a tailor, aged 17, who had diseased vertebræ and spinal curvature, together with a fistulous abscess in the left thigh. He died without any paralysis, yet were there two vertebræ and the lower half of the lumbar swelling of the cord absolutely destroyed.

The case reported by my late friend Mr. Stanley to the Royal Medical and Chirurgical Society is so generally known, that I ought, perhaps, to apologize for quoting it. The disease was not the result of an accident, but came on spontaneously and increased progressively. Loss of motion became complete throughout the whole extent of each lower extremity, but in no part was there defect of sensibility; scratching, pricking, or pinching being attended by sensations as acute as ever.

On examining the body, no disease was found in the anterior columns of the cord; but the whole of the posterior, from the pons to the lower end of the cord, were changed in colour and consistence.†

An exactly similar case has been reported by Dr. Budd.

* "*Mémoire sur quelques Altérations de la Moëlle Epinière, dont les Observations principales ont été recueillies à la Clinique et sous les yeux de M. le Professeur Bourgon,*" tome vii., p. 329.

† "*London Medical Gazette,*" February 7, 1840.

Considering the marvellous uniformity which exists in the anatomical structure of every organ, and the special function of each individual tissue; considering, too, the unvaried results of experiments when performed on the same part of the nervous system, in the same manner and under precisely the same conditions, in the lower animals; I am more disposed to believe in the incomplete examination of pathologists than in any freaks of nature. How seldom, for instance, is the grey substance of the cord adequately examined during a post-mortem investigation! and yet there it is—if the starting-point of every nervous fibre contained in the anterior roots of nerves mean anything—that we should look for an efficient cause, for there it is that every muscular motion must originate. Then, again, to what false conclusions may the varying conditions of the spinal marrow lead us when it is examined after death! It has been already observed that no part of the animal body undergoes such rapid changes as does the nervous system when its vital action has once ceased; and yet how prone are we to infer that as we find it, such was its state at the last moment of life, and thereupon to dilate on the discordance between its physiological action and its morbid condition!

*Lateral Curvature of the Spine produced by Paralysis of
the Muscles of Respiration.*

Before I leave this part of my subject, a few observations on the ingenious theory of Dr. Stromeyer,* which attributes to partial paralysis of the muscles of respiration the ordinary form of scoliosis, may not be considered out of place.

The dependence of the muscular tissue for its healthy contractile power upon a constant and adequate supply of arterial blood is too universally admitted to require being insisted on here. On this axiom Dr. Stromeyer conceived a doctrine which is worthy of consideration, seeing that it may suggest means

* “Ueber Paralyse der Inspirations Muskeln, von Louis Stromeyer.” Hanover, 1836.

both of prevention and cure available for the purposes of everyday practice.

The accessory muscles of respiration possess two distinct functions ; the one appertaining to voluntary motion, the other to respiration ; and these functions are dependent on two distinct sets of nerves.

The *sterno-cleido-mastoideus* and *trapezius* muscles have nerves going to them from the cervical plexus for the purpose of moving the head and shoulders, whilst they also receive a special nervous influence from the spinal accessory nerve. The *serratus magnus anticus*, too, has nerves from the dorsal plexus, because it has to assist in the motions of the body in locomotion ; but it receives also the so-called external respiratory nerve, which is, as Sir Charles Bell first called it, the counterpart of the internal or phrenic nerve.

To make this part of Dr. Stromeyer's theory more intelligible, I will take the liberty of transcribing Sir Charles Bell's observations on these three muscles.

1. "The *sterno-cleido-mastoideus*, by its attachment to the sternum and to the clavicles, raises or heaves the chest. The usual description of the muscle is to consider it as a muscle of the head, the lower attachments being the origins ; but when the head is fixed, it becomes a muscle to raise the chest, and its operation is evident in all excited states of respiration, in speaking, and still more in singing, coughing, and sneezing. But there is something necessary to the full effect of this muscle on the chest ; for otherwise it will be a muscle of the head, and not of the chest. This leads us to the next muscle."

2. "The *trapezius* must fix the head or pull it backwards before the mastoid can act as a respiratory muscle ; and how they are combined we shall presently see. The position of the head of the asthmatic during the fit, as well as the posture of the wounded or the dying, prove the influence of the upper part of the trapezius in excited respiration : that is to say, when the shoulders are fixed, this muscle, usually described as a muscle of the superior extremity, becomes a muscle fixing the head." "The trapezius has a still more powerful and important influence in respiration when the action rises above the ordinary condition ;

and that is by drawing back the scapula, to give necessary effect to the action of the serratus magnus on the ribs."

3. "The *serratus magnus anticus* being extended over the whole side of the chest, and attached in all the extent from the second to the eighth rib, is very powerful in raising the ribs and holding out the margins of the chest, which would be otherwise drawn in by the diaphragm; and to this effect, the intercostal muscles alone would be insufficient in the high or excited state of respiration. But it cannot exert this power independently of the trapezius; since, without the combination explained above, its force would be exerted in its more common office of moving the scapula, and not the ribs. Unless the scapula be fixed, or pulled back by the trapezius, the serratus is not a muscle of respiration."

"In this manner do these three powerful muscles hold together in their action, combining with the diaphragm to enlarge the cavity of the chest in all its diameters. These external muscles do not interfere with the gentle actions of breathing. But if the apparatus of respiration is to be employed in any excess of action, in passion, in dying, in speaking, singing, coughing, yawning, etc., these become powerful instruments."

Now, it is to the defective energy of these accessory muscles that Dr. Stromeyer attributes scoliosis, or lateral curvature of the spine.

The action of the serratus is to keep the ribs stretched outwards, backwards, and upwards; to raise them and hold out the margins of the chest: but when from any cause, as in individuals whose exercise is inadequate to the maintenance of a healthy circulation and vigorous muscular action, the serrati fall into weakened and diminished action, their opposing muscle, the diaphragm, draws the sides of the chest downwards and inwards; and as the left serratus is generally less active than the right, there is a resulting concavity of the left side of the chest. This begins immediately under the axilla; and no sooner is the equilibrium disturbed than the serratus of the concave side acts under unfavourable circumstances. Thus, the more it is enfeebled, the more does the diaphragm pull in the ribs of that side, and the trapezius of the arched side comes to assist in the distortion of the bony framework of the entire trunk.

It must be admitted that the theory is exceedingly ingenious : and it has the incidental advantages of harmonizing with the most recent investigations on the influence of the vaso-motor nerves, on the functions of respiration and nutrition ; and of indicating a system of treatment the most likely to improve the general health, by increasing the tone of the inspiratory muscles.

CHAPTER III.

PARALYSIS FROM AFFECTIONS OF THE BRAIN.

THERE are special circumstances associated with paralysis dependent on affections of the encephalon which tend to render its character more ambiguous, its prognosis more problematical, and its treatment more obscure, than is the case of the same result proceeding from analogous diseases of the spinal marrow.

1. The obvious subdivision of the brain into at least four great segments, all being intimately associated, yet each acting as an independent centre. The consequence of this is, that the same form and degree of paralysis may be occasioned by a lesion of any one centre, or of the nervous tracts connecting it with another.

2. The physical peculiarity resulting from the encephalon and blood circulating in it being incompressible, and absolutely filling the cavity of the unyielding skull. The consequence of which is, that if there be a preternatural distension of vessels, effusion of serum, extravasation of blood, or a tumour formed in any one part of the brain, the space so occupied must of necessity affect every other part, and proportionally deprive it of its normal supply of food.

But even these sources of fallacy may be greatly diminished by a careful study of the correlation between symptoms and the seat of lesion. It must, however, be admitted that in spite of all the inferences which have been deduced from the most careful observation of disease, the ordinary difficulties which the most sagacious physician encounters in his daily occupation

with the phenomena of life are intensified by extraordinary cases, which are constantly presenting themselves, and appearing to set all general rules at defiance; and in no cases are these difficulties more common than in affections of the brain.

Paralysis from Apoplexy.

Perhaps the most simple form in which sensation and voluntary motion are suspended—if the term simple may be applied to the mysterious function which originates the sense of touch and the contraction of muscles—is that observed in an ordinary fainting fit, in which we see how immediately subordinate are the nervous dynamics to a supply of blood adequate to the healthy nutrition of the brain, and how directly the cerebral functions cease on the occurrence of any interruption to such supply.

And so it is in apoplexy: the stoppage of the healthy flow of blood in the nervous centres occasions paralysis. But although it is assumed that there is thus much of analogy between syncope and apoplexy, that there is in each an interrupted circulation of blood in the brain, yet every medical practitioner knows that this resemblance of relations does not justify the inference that the state of the brain is the same in both. The two conditions of disease are the very antitheses of each other, although, as in many other parallel phenomena proceeding from the sensorium, the effects are similar. In syncope there is a deficiency of blood sent to the brain; in apoplexy there is often a state of engorgement of one set of vessels of that organ; and when such congestion occasions an effusion of serum or an extravasation of blood, paralysis is the almost invariable result. This may present an infinite variety in extent and completeness of degree, as the case-book of every medical practitioner would testify. Seeing, therefore, that the shades of difference are so familiar to every one, it would be superfluous to give a long list of cases, and I will select such only as may be most interesting and most instructive.

CASE 29.—J. H., Esq., aged 32, after feeling unusually lethargic for some few days before (April 27, 1849), suddenly lost the power of

speech. In less than three hours he regained it completely, and has been well since. From the very short duration of the paralysis, it is not, I think, unreasonable to suppose that a transient state of congestion, such as the French call a *coup de sang*, incompatible with the healthy function of that part of the medulla oblongata in which it occurred, was the cause of the attack.

CASE 30.—The like disaster befel a lady, aged 63, after visiting the Great Exhibition of 1851. On her way home she became speechless, and three or four days elapsed before she regained the power of articulation. Some two years after, she had an attack of apoplexy and hemiplegia. The loss of speech was probably occasioned by the extravasation of a very small quantity of blood in or about those ganglia of the corpora olivaria from which the hypoglossal nerves originate; and the presumption that such was the case is increased by the fact that a slight ecchymosis was superinduced on the inner edge of the cornea in one eye, apparently from the ciliary branches of the ophthalmic artery, which disappeared as the command of the tongue was restored.

There are several cases referred to by Professor Schröder Van der Kolk to prove that the corpora olivaria are the organs for the articulation of the voice. In one, the subject of which was a gunner who had been bitten by a serpent, the ordinary symptoms of giddiness and faintness came on; but there was also a total loss of speech, consciousness remaining unimpaired; and on examining the body four hours after death, the chief indication of morbid action in the nervous centre was a greatly congested condition of the medulla oblongata, especially between the corpus olivare and corpus restiforme.*

The following interesting case of paralysis of the facial nerve, with disturbance of the acoustic, glosso-pharyngeal, and pneumogastric nerves, has lately fallen under my observation:—

CASE 31.—F. B., Esq., of Philadelphia, aged 67, after much bodily fatigue and very great anxiety concerning his country, was seized at Baden-Baden with a sudden attack of headache, with vomiting and loss of consciousness, from which latter he rallied in a few hours, but was left with the mouth slightly drawn to the left side, drooping of the right eyelid, deafness of the right ear, disabled lips and consequent incapability of uttering any labial sounds, a constant and

* “On the Minute Structure and Functions of the Medulla Oblongata,” translated for the New Sydenham Society by W. D. Moore, A.B., M.B., p. 162.

distressing flow of saliva from the mouth, considerable difficulty in the act of deglutition, and distressing paroxysms of dyspnœa on falling asleep. When perfectly quiet, there was nothing remarkable in the case, except the hanging down of the lower lip, and perhaps of the cheek also; but those who were familiar with his countenance in health did not observe this latter. When, however, an attempt was made to speak or smile, there was a marked distortion of the features, in consequence of the inaction of the right side.

Now, it has been affirmed that the facial nerve is seldom or never affected by cerebral disease; but this appeared to me and to my friend Dr. Hodgkin an unequivocal example, although the patient could well-nigh close the right eye, which M. Trousseau is disposed to think cannot be done when the *portio dura* is affected.

As an instance of diffused influence of emotional impression, this case would perhaps be more correctly placed under the head of reflex paralysis; for this latter may have had a centric origin and been attributable to a source within the cerebrum, just as the opposite phenomenon of excited muscular action of automatic form and cerebral origin is often induced by insanity, but inasmuch as the paralysis resulted from effusion or mechanical pressure, probably in the medulla oblongata near to the nucleus of the facial nerve,* I have referred to it here.

The case is, furthermore, interesting as touching a remark by Dr. Laycock, in a paper "On the Reflex Function of the Brain," † read at York before the Medical Section of the British Association for the Advancement of Science, that emotions of the mind act principally on the excito-motory system by relaxing the sphincters, and inducing vomiting, micturition, and defecation. In my patient, however, I am disposed to think that the nucleus of the pneumo-gastric nerve was affected; and it is a matter of some importance, seeing that emetics are sometimes given with a view to relieve a disordered condition of stomach. Three emetics were, in fact, given to F. B., but without arresting the disposition to sickness.‡

* Op. cit., plate iii., fig. 4.

† September 28th, 1844.

‡ I find in my note-book two cases somewhat illustrative of Dr. Laycock's observation:—

CASE 32.—J. E., Esq., aged 25, was seized with vomiting and insensibility

The great flow of saliva and paroxysms of dyspnœa beautifully exemplify the diffusion of morbid impressions and influence of changes occurring in the sympathetic and inspiratory nerves by the connecting branches of the seventh pair.

The following is an example of facial paralysis as proceeding from an affection of the portio dura. It is recorded by M. Trousseau,* and I quote it to illustrate the different condition of the palsied eyelid in this latter affection:—

CASE 34.—A youth, aged 17, when in a state of perspiration, fell asleep on a heap of stones, the day being very cold. He caught cold, and returned home with uncomfortable feelings. The next morning he arose tolerably well; but on beginning to eat, he experienced some embarrassment in mastication: the food getting outside the teeth on the right side, he was obliged to press his hand against the cheek to force the food back again between the teeth. He had no pain, and was yet more astonished when told that his mouth was on one side, and that the deviation was still greater when he laughed. In repose the right side of the face appeared only a little flatter than the left, and the right eye was wider open. In other respects there was nothing particular in his face. On talking, however, and more especially if he laughed, the left commissure of the lips was drawn outwards and upwards, whilst on the right side there was perfect immobility, which extended to the *eyelids*, cheek, and lips. The muscles of the eyeball acted well, but the orbicularis palpebrarum of the right side could not be closed. The sense of sight was perfect; the tongue was protruded in a straight direction, but the articulation of labial sounds was difficult. The uvula, moreover, was drawn a little to the left side. The general health was not in the least affected, neither was the sensation of the right side of the face.

These cases of idiopathic facial paralysis generally terminate favourably; and the more rapidly they come on, the quicker do they get well.

after a day of great excitement at a cricket-match. Slight hemiplegia followed. About ten months after, having been again excited on the Epsom race-course, he had another and precisely similar attack, which left him with entire loss of motion of the right arm and leg.

CASE 33.—A. T. had an attack of apoplexy on the day that a bill which he was unable to pay became due. In the early morning sickness and vomiting came on, paralysis and coma quickly followed, and death followed in less than twenty-four hours.

* "Clinique Médicale," vol. ii., p. 284.

The power over the orbicularis palpebrarum, therefore, is the only perceptible difference; and Dr. Cazalis, of the Salpêtrière, has described the imperfectly palsied lid as a diagnostic sign of facial paralysis dependent on intra-cranial hæmorrhage, and the perfectly fixed lid as indicative of affections of the nerve only.

M. Trousseau adds, that in intra-cranial disease the muscle answers to a galvanic current, but not so in affections of the nerve itself. MM. Duchenne and Vulpian have verified this fact. I suspect also that it will be found in all cases of facial paralysis dependent on intra-cranial disease, the morbid impression will be diffused more or less to neighbouring nerves. M. Trousseau, in drawing a distinction between cerebral hemorrhage and apoplexy—which latter he characterizes by a sudden loss of consciousness, sensibility, and motion—speaks of a man who was admitted into the Hôtel-Dieu for a chronic pulmonary catarrh, in whom, without any premonitory head symptoms, a slight impediment of speech occurred, and a little difficulty in using the fingers of the right hand. In a very short time the mouth was drawn upwards to the left side, whilst the cheek of the right side was flat and immoveable. The tongue, when protruded, *appeared* to be turned to the left side; but that was owing to the distortion of the mouth. The right arm also lost power, but the right leg was unaffected. M. Trousseau diagnosed slight hæmorrhage into the left cerebral hemisphere without any affection of the facial nerve, in consequence of the incomplete paralysis of the face. But the patient recovered completely, so that the diagnosis could not be verified.

In facial paralysis produced by a lesion of the medulla oblongata, the palsied side is opposite to that in which the disease of the nervous centre exists: consequently, if hemiplegia be present also, the mouth is drawn towards the healthy side of the body. And this is in strict accordance with what Van der Kolk has shown to be the course of the nerve-fibres,* the greater part of which, arising from the nucleus, pass into the raphe, and radiate to the opposite side. This decussation is probably for the purpose of establishing a bilateral action of the nerves, so that both sides of the face may move symmetrically.

* Op. cit., p. 118-9.

An apparent exception to the above rule may exist where, from irritation, there is spasmodic contraction of the muscles of the palsied side. Dr. Graves, of Dublin, has described such a case; and M. Trousseau also relates the case of a young woman who, from spasm of the muscles of the right side of the face, made the left, or healthy side, appear to be paralyzed, except that the gaping eye was on the right side.

Speech, and the manifestation of speech, as indicated by the countenance, together with the sense of hearing, are the functions which appear to be affected by lesions of the ganglia contained in the medulla oblongata; but loss of speech has been observed to result from structural lesion of the anterior lobes of the cerebrum, as I shall have occasion to notice.

CASE 35.—W. H., aged 40, was admitted into St. Mary's Hospital, having, some two months before, been thrown from a cart, by which he was stunned, and continued so for five or six hours. Three or four days after the fall, his face was drawn to the right side, and continued so. On admission, he complained of pain in the back part of the head and giddiness, especially after rising in the morning. His articulation was considerably affected and his sense of hearing also. The angle of the mouth was drawn upward and to the right side; the tongue, which was clean, when protruded, was directed towards the left. His head was cool, his appetite good, his pulse 62, and his health generally was good. He stated that after the fall he spat blood. With the twentieth of a grain of strychnia three times a day, and a blister to the nape of the neck, he improved rapidly.

In this case the functions of the medulla in the vicinity of the origin of the seventh pair of nerves was temporarily suspended, probably from simple concussion.

Respiration, too, as we have already seen, is equally under the influence of the medulla oblongata, and an exceedingly interesting case is recorded by Dr. Calmeil.* The subject of it was a man, aged 30, who, after suffering from symptoms of cerebral affection, was suddenly seized with difficulty of breathing, loss of consciousness, and, whilst mustard poultices were being prepared to apply to his thighs, and his arm was being prepared for bleed-

* "Traité des Maladies Inflammatoires du Cerveau," tome i., p. 39.

ing, he died. On examination of the body, the surface of the fourth ventricle was fairly raised by injected blood-vessels beneath, but there was no positive extravasation of blood.

Many cases of apoplexy of the pons Varolii have been reported, and, in most, the symptoms have accorded with the structure of the organ, as well as with the deductions of Dr. Hermann Weber as contained in his "Contribution to the Pathology of the Pons Varolii," * to which I shall have occasion to refer.

CASE 36.—M. D., a muscular man of middle height, with a short, thick neck, and large head and shoulders, whilst working in the open air, complained suddenly of a buzzing in his ears, and, a few minutes after, of acute pain in his head; whereupon he started off running, but soon fell, presenting the following symptoms:—Complete loss of consciousness; pallor of face; perfect immobility of the pupils, which were equal in diameter and not dilated; the eyelids half closed at first, gradually closing entirely—the right one shortly after the left; immobility of the eyeballs; mouth half opened; the tongue covered with arterial blood, and occasionally forced between the teeth, but without deviation either to the right or left side; the lips covered with frothy saliva, but without any convulsive action of the mouth. Respiration frequent, irregular, occasionally stertorous, and with a noise like that which is often heard in epilepsy; the alæ of the nose contracting convulsively with the respiratory muscles. Twice the patient sneezed violently whilst lying on his back, and bent himself forward in each act. His limbs were stiff, but could be bent without great difficulty. The contraction and rigidity of the muscles, however, were not permanent, but ceased for a few instants occasionally, when the limbs became supple, especially the right arm; then the muscular contraction would suddenly return and continue for some time. The convulsions presented a mixed character between clonic and tonic, but tending towards the latter. In the neck, the muscles were not so rigid but that the head would incline towards either side according to the position of the body. With regard to sensibility, it was difficult to determine whether it was abolished or not; a slight convulsive movement was observed in the right arm when it was pinched, and when it was punctured for bleeding.

Altogether the attack was somewhat like an epileptic fit; but the patient had never had epilepsy before. He died five hours after being first attacked; but he was not watched by M. Bérard, who was called to him, during the last two hours.

* "Medico-Chirurgical Transactions," 1861, vol. xliv.

On examining the body, the pons Varolii was found converted into a sac filled with partially coagulated blood, mixed up with shreds of softened nervous matter. The extravasated blood had escaped, to some small extent, by a minute lateral opening in the pons; but a larger rupture gave passage to the blood into the fourth ventricle, which was distended.

I have copied this case from M. Ollivier,* who speaks of several other cases of apoplexy of the pons, in all of which convulsive movements, together with inward rotation of the arms, were observed; and although paralysis is not alluded to in the instance just quoted, it unquestionably existed.

CASE 37.—A coachman, aged 46, who partook largely of porter, was suddenly seized with apoplexy. When I arrived, the wife and brother, who were with him, had discovered that the left nostril appeared to be insensible to the influence of strong ammonia which had been used with the view to overcome a convulsive paroxysm. There was, in fact, anæsthesia of the left side of the face. There was also hemiplegia of the right arm and leg; but about every quarter of an hour strong convulsive movements occurred on the left side of the body, and apparently in the pectoralis major and latissimus dorsi of the palsied side, so that the right arm was drawn forward and inward: there was also a very rigid condition of the biceps. These paroxysms would continue for about five minutes, and in the intervals the right side of the body lay perfectly motionless. The biceps, however, of the affected arm retained its stiffness, and an attempt to extend it produced intense pain and convulsive movements generally. The mouth, too, was continuously and rigidly closed. These symptoms continued for about seven hours, when the patient sank into a state of coma, and death ensued two hours after.

On examining the body twenty-eight hours after death, the whole of the interior of the left side of the pons Varolii was filled with a coagulum of blood. The encephalon generally, and its membranes, were injected with blood; and a considerable quantity of serum was found in the ventricles and at the base of the brain.

The principal symptoms in the above case were obviously dependent on a solution of continuity of the fibres of the left pyramidal body, of the sensitive portion of the left trifacial

* Op. cit., vol. ii., Obs. 64.

nerve in the substance of the pons, and on the irritation set up by the extravasated fluid in the contiguous ganglionic cells and conducting nerve fibres, which retained their integrity.

It is due to M. Gubler to state that, as early as 1856, he predicated of the pathology of the pons, *on anatomical grounds alone*, that a lesion of one-half *should* cause hemiplegia of the limbs on the opposite side of the body, and paralysis of the face on the side corresponding to the lesion (*paralysie alterne*); and he explains it thus:—"The lesion," says he, "implicates the facial nerve after its decussation: hence the paralysis is direct for the face, but opposite for the body and limbs."

The question which next suggests itself is, what are the pathognomonic signs of apoplexy of the cerebellum? To which it may be replied, that paralysis is not necessarily one. Nor is there any other which is present in *every* case of extravasation into either the medulla oblongata or pons Varolii. But if every case be made the subject of a special study, rarely will the symptoms be found to be inconsistent with the anatomical structure of the diseased part. The following case, reported by Dr. Alderson,* is an apposite illustration.

CASE 38.—Mary Ann White, aged 21, servant, admitted into St. Mary's Hospital February 8th, 1861. A fortnight ago, without any apparent cause, she was suddenly attacked with extreme pain over the lower portion of the occipital bone. The pain was accompanied by bilious vomiting, which, during the first few days, was nearly incessant, both by day and night. The pain at the back of her head has continued ever since, and during the last few days has been getting worse. The vomiting, though less severe than during the commencement of the attack, has come on to some extent every day.

The patient appears to be in intense pain, and constantly keeps up a half-suppressed moan. She is unable to take any food. The bowels are natural; pulse 64; skin sometimes hot and dry, sometimes cold; tongue furred. The pupils contract naturally, and are not unusually either contracted or dilated. *Sensation and motion are both perfect. There is no hemiplegia nor paraplegia.* The mind is quite unaffected. She describes the pain as intense, and as if a hole were being bored at the back of her head.

From the time this report was taken, till her death, about twelve hours later, no change occurred.

* "British Medical Journal," March 23, 1861.

MORBID APPEARANCES.—The dura mater was healthy. The surface of the hemispheres presented the usual degree of vascularity; they seemed to bulge somewhat, and the convolutions appeared slightly flattened. The substance of the brain was of normal consistence, a little whiter perhaps than usual. The ventricles were much distended, containing about two ounces of clear, colourless serum. There was no softening at any part of the walls of the ventricles, nor any unusual vascularity. When the encephalon was removed from the cranial cavity, the left side of the cerebellum was noticed to be rather large, and to the touch it felt soft. An incision was made into its under surface along the centre of the middle crus cerebelli, from the pons to the outer border of the left lobe; and a clot of blood was exposed at the anterior and internal part of the lobe. The clot appeared to be of considerable size: it was black and soft. The sides of the cavity in which it was lodged were smooth and of a pink colour. There was staining of the dura mater in the cerebellar fossa, but none of the extravasated blood had escaped from the cerebellum. The other viscera were healthy.

There was no loss of power either of motion or of sensation, nor difficulty in speaking; for within an hour of her death she got out of her bed without assistance, and asked if she might have tea as often as she liked, as it was the only thing she really enjoyed. There was no loss of consciousness, and no affection of breathing. But the fixed pain, the vomiting, the plaintive voice, and a weak pulse, were the only symptoms which indicated the grave nature of the disease.

CASE 39.—In another case, recorded by Mr. Dunn,* the subject of the disease a thin, nervous man, aged 52, was first afflicted with an amaurotic affection, after which he suffered from an attack of headache, with agonizing pains through his temples and some febrile disturbance, which, under the influence of local bloodletting and a strict antiphlogistic diet, subsided, but the sight became more impaired.

Some four years after, in consequence of anxiety and embarrassment in his pecuniary affairs, he lost his physical energy, became very nervous, despondent, and subject to emotional excitement,—bursting into tears when allusion was made to his wife and family, to whom he was tenderly attached: his memory and mental powers generally also became greatly impaired.

Such was his state of health when he was suddenly seized with sick-

* “Medico-Chirurgical Transactions,” 1849, vol. xxxii, pp. 107—114.

ness and faintness during one night, and on getting out of bed to pass water, fell down, as it was thought in a fainting fit. He was low and exhausted, with a feeble pulse, and a cold, clammy perspiration upon the surface of the body; complained of sickness of stomach, and of pain, heat, and uneasiness in the back part of his head. Mr. Dunn gave him ammonia with Hoffman's anodyne, and he rallied in the course of the day; but the pain, heat, and uneasiness of the head continued for some days afterwards. There was no paralysis on either side; but there was about him a hurried manner, great restlessness and irritability of temper. He did many strange things, such as getting up in the middle of the night and putting on his clothes, then going to bed again half dressed, &c. His emotional excitability increased, and was distressing to every one about him. His appetite was good, but his mental faculties weakened, and Mr. Dunn diagnosed ramollissement of the brain. He also became the subject of a constant desire for sexual intercourse, in consequence of which he was persuaded to pay a visit of three weeks to some friends in the country without his wife.

He returned looking better, apparently improved in his general health, and no longer a slave to the sexual propensity. In this respect he had greatly changed. The desire for sexual intercourse abated, and gradually became less and less up to the time of his death, which took place about five months after the attack of sickness.

On the day of his death, after having eaten a hearty dinner, he was seized with severe pain in the back part of his head. He described it, after rallying a little, as though he had received a sudden blow on the part. It was immediately followed by faintness, sickness, and vomiting. Soon after he became restless and irritable, and then had a severe convulsive rigor, which was followed by coma, with stertorous breathing, and a feeble, fluttering pulse. He gradually sunk, and died in less than four hours from the time of the attack.

Examination forty hours after death.—The vessels on the surface of the brain were found distended with dark-black blood. The brain itself presented an unhealthy aspect. The convolutions shrunken in size, and wanting in firmness of texture, were of a dingy yellow hue, approaching to the colour of whity-brown paper.

The optic nerves had the same shrunken character and dingy hue; and on tracing them from the chiasma through the optic tracts into their cerebral connexions, they and the surrounding substance were found to be in a state of whitish-grey softening; the whole region of the mesocephale had an unhealthy aspect, and on its outer surface were seen patches of the same whitish-grey degeneration. The ante-

rior of the right hemisphere of the cerebellum had become a softened, pulpy mass, in the midst of which was found an apoplectic clot, of the size of a pullet's egg, from the rupture of one of the branches of the vertebral artery. The softening had extended inwardly beyond the centre of the median lobe, implicating the fibrous strands of the middle and inferior planes in the destructive process, and outwardly so near to the surface of the hemisphere, that a portion of the apoplectic clot was projecting through it. The whole arterial system of the brain was more or less unhealthy, presenting that diseased condition of the vessels which results from cartilaginous and ossific deposition between their coats. In the vertebral arteries this was remarkably apparent. There was seen, at very short distances from each other, a succession of osseous rings; while on the right side the vessel was enlarged, and upon its cerebellar branch, in which the rupture appeared to have taken place, there were whitish raised patches of cartilaginous deposits.

Here, as in the case described by Dr. Alderson, there was no paralysis except that which occurred in the optic nerves, obviously from the structural change which they were found to have undergone; nor ought we to expect any, looking abstractedly at the anatomical relations of the organ, and disregarding the symptoms which we are in the habit of associating with our ideas of extravasation of blood into the substance of the brain.

Communicating with the corpora quadrigemina above, and with the corpora restiformia below, the idea suggests itself that it is the meeting-point of all the sensorial tracts; and so far we have a clue to the emotional excitability which is a prominent feature in most cases of diseased cerebellum; and the question naturally suggests itself, whether emotional sensibility may not have a distinct nucleus or centre in the cerebellum.* In nine cases of hæmorrhage into the *middle* lobe of the cerebellum, seven presented phenomena of excitation of the genital organs.† Six of these were seen by M. Serres. The subjects

* In a case of softening of the cerebellum described by Dr. Menard ("Revue Médicale," tom.i., p. 388), the subject, although a child aged fourteen months, was observed to have the penis in a state of semi-erection during the whole course of the disease. Dr. Cafford has reported another case, in the "Archives Générales de Médecine," tome xxii., p. 133, in which an erotic mania coexisted with inflammation and softening of the grey cortical substance of the cerebellum.

† Andral's "Clinique Médicale," vol. v., p. 673.

of five were men in all of whom there was priapism. One was a female, aged 70, who had a sanguineous discharge from the vagina at the very moment of the attack; and after death the uterus was found full of blood-clots, whilst the Fallopian tubes and ovaries were red and turgid.

An anecdote is related of Valsalva, that being called to a patient in a state of apoplexy, he predicated that the cerebellum was the seat of lesion, in consequence of priapism which existed; and M. Serres, from the above evidence, has affirmed that erection of the penis is a pathognomonic sign of cerebellar apoplexy. When the lateral hemispheres only of the cerebellum are the seat of an apoplectic clot, there is no particular symptom with which we are at present acquainted which is an invariable attendant of the lesion, although vomiting is almost always present, especially when the extravasated blood is found near the under surface of the organ. Out of seven cases cited by M. Andral, in three only did hemiplegia exist; and in those it was always observed to be the result of a cross-action, as in apoplexy of the cerebrum.

It would be an irksome and useless task to describe the various forms and degrees of paralysis which may result from *cerebral* apoplexy. A single nerve may be affected, and the tissues supplied by it have their functions destroyed. A single limb may be deprived either of sensation or of motion, or of both. The entire half of the body may suffer in like manner; and in the most severe cases every organ and every faculty may be struck by a sudden and instantaneous deathblow. Either sensation or motion may be destroyed; but for the most part it is the latter: or the extinction of both may occur together; when, if life be preserved, sensation generally returns, and leaves the paralysis of motion. Sometimes it happens that the stroke, which lays motionless one side of the body gives rise to convulsive movements of the other; and occasionally, when motion only has been destroyed, it has been observed that the remaining sensibility of the part has been morbidly increased.

It may be interesting to know the comparative liability of the different parts of the nervous centres to be affected by apoplexy; for, if by associating the symptoms with the respective lesions, or by any other means, it be possible to deduce

a diagnosis with regard to the locality of disease, much light may be thrown upon the regularity of nature's operations, and order and method may be exhibited in the midst of what still appears to be intricacy and confusion.

To Morgagni,* Rochoux,† and Andral,‡ we are chiefly indebted for information relative to the first of these questions; and one most encouraging circumstance connected with the tabular forms which these three pathologists have given us is the remarkable agreement as to the result of their investigations. Andral has classified no less than three hundred and eighty-six cases which require little or no comment.

TABLE SHOWING THE COMPARATIVE FREQUENCY OF HÆMORRHAGE IN THE DIFFERENT PARTS OF THE CEREBRO-SPINAL AXIS.

In the cerebral hemispheres, on a level with the corpora striata and optic thalami, and at the same time within those bodies	202
In the corpora striata	61
In the optic thalami	35
In the hemispheres above the centrum ovale	27
In front of the corpora striata	10
In the centrum ovale of middle lobes	9
In the posterior lobes behind the optic thalami	7
In the crura cerebri	3
In the lateral lobes of the cerebellum	16
In the middle lobe of the cerebellum	5
In one crus cerebelli	1
In the corpora olivaria	1
In the pituitary gland	1
In the spinal cord	8
	386

Notwithstanding these pathological facts, and the great majority of cases in which the corpora striata and the optic thalami appear to be the seats of structural lesion in apoplexy, it is still a matter of uncertainty what parts of the brain are the organs of motive impulse for the superior and inferior extremities.

Andral has, moreover, described seventy-five cases § in all of

* "De Sedibus et Causis Morborum per Anatomem Indagatis."

† "Dictionnaire de Médecine," art. Apoplexie Cérébrale.

‡ "Précis d'Anatomie Pathologique," liv. ii., p. 739.

§ "Clinique Médicale," tome v.

which the cerebral hæmorrhage was sufficiently circumscribed to illustrate the difficulty of the question.

1. In forty there was hemiplegia affecting both arm and leg. In twenty of these cases there was hæmorrhage in the corpora striata; in nineteen it occurred in the optic thalami; and in one case only the extravasation existed in the middle lobe between the two bodies.

2. In twenty-three the paralysis was confined to one arm. In eleven of these cases there was hæmorrhage in the corpora striata; in ten it occurred in the optic thalami; and in two, in the middle lobe.

3. In the remaining twelve cases there was paralysis of one leg only. In ten of these cases extravasated blood was found in the corpora striata; and in two, in the optic thalami.

From the above, it appears that blood extravasated into the corpora striata alone, or into the optic thalami alone, is sufficient to produce paralysis of one arm, or of one leg, or of both arm and leg; and inasmuch as we have positive evidence to show that the same accident occurring in any other part of the cerebrum is not necessarily productive of hemiplegia, we have great reason to believe that both corpora striata and optic thalami are intimately associated with the function of voluntary motion.

That a paralyzing lesion may occur in any other part of the brain is an undoubted fact; but it appears that in all such cases the immediate cause of hemiplegia is pressure exercised either on the corpora striata or optic thalami, or on the nerve-fibres connecting those bodies with the medulla oblongata; or a solution of continuity of those fibres; or, as Dr. Brown-Séquard has suggested, from reflex action originating at the periphery of the nervous system; or in a portion of the brain itself, which then acts in the same way as any other organ placed at the periphery. In either of these latter cases the seat of the organic lesion is not the seat of functional disturbance.

Until pathologists are in the possession of data necessary to demonstrate the relationship which probably exists between the lesions of the several parts of the cerebrum and their respective external manifestations, the most useful course to pursue is to lay before the reader those inferences which have been drawn

from the most extensive observations of experiments and pathological cases.

It is well known, for instance, that the cerebral hemispheres may be sliced away down to the corpora striata and optic thalami without producing paralysis; and cases have been recorded wherein considerable extravasation of blood has occurred on the surface and in the cortical grey substance of the brain without any perceptible loss of motion; but I am not aware of any such case where consciousness has not been more or less affected.

M. Lenormand relates a case in which a copious extravasation of blood was found in the cortical substance of both hemispheres of the cerebrum without any paralysis;* and an instance is recorded by M. Secretin† in which an apoplectic clot, the size of a hen's egg, was found in the posterior lobe of the right hemisphere of the cerebrum; but there was no paralysis. The following case is described by Dr. Abercrombie: ‡—

CASE 40.—A gentleman, about 63 years of age, tall and slender, and of temperate habits, was seized with apoplexy on the morning of the 2nd of May, 1822. He was promptly relieved by bleeding, continued well through the day, and on the morning of the 3rd appeared free from complaint. About two o'clock, however, there was a return of the attack, when he was again bled copiously, but without the effect of restoring consciousness. He was now seen by Dr. Barlow, and all the usual remedies were employed in the most active manner without relief. On the 4th he was still comatose, and continued so till ten at night, when consciousness returned, but continued only for a very short time. On the 5th he had an interval of recollection, which lasted three hours; and he was again sensible for about a quarter of an hour in the evening. He had a similar interval for about an hour and a half on the 6th, but on the 7th was comatose nearly the whole day. On the 8th there was a slight return of consciousness in the morning; and towards the evening he was sensible for several hours. During these changes the bowels had been fully opened; the pulse had continued about 72, and soft; *and no paralysis of any limb had been observed.* On the 9th he was lethargic,

* "Journal Hebdomadaire de Médecine," i.; 1828.

† "Cours de Pathologie Interne," par M. G. Andral, tome ii., p. 523.

‡ "Researches on the Diseases of the Brain," p. 230.

with some stertor ; but after topical bleeding, and the operation of a purgative, he was much relieved ; passed a quiet night, and on the morning of the 10th he was quite sensible. It was now first observed that he had lost the sight of the right eye, which was distorted outwards. On the 11th he lay with his eyes shut, but took food and answered questions intelligibly when he was spoken to. On the 12th he was lethargic, but capable of answering questions when he was roused ; and this state continued on the 13th. On the afternoon of that day there was an increase of stupor, with difficulty of swallowing. He was again partially relieved by leeches, a purgative, and a blister to the neck ; but the relief was only temporary. He became gradually more comatose, and died early on the 16th.

INSPECTION.—A copious extravasation of blood was found extended over the surface of the brain : it was closely adherent to the dura mater, and could be peeled off like a membrane. The substance of the brain was healthy. There was no effusion in the ventricles.

When paralysis results from extravasation of blood into the ventricles, the character of the palsy may be very ambiguous, as indicative of the locality of the effusion ; but all other symptoms are significant of extensive and progressive mischief. A sudden attack of headache, sometimes instantaneous, and often with the feeling of an unusual shock in the head, which generally excites an alarming exclamation ; a rapid transition from the ordinary condition of mind to a state of unconsciousness, during which the patient sometimes contrives to stutter out a half-finished sentence, or, if unable, shows, perhaps, by tears his distress of mind, in the momentary consciousness of a palsy which is quickly stealing over his senses and his power of motion. Hemiplegia of one side of the body. The pulse, whether affected or not at first, becoming sooner or later irregular ; the palsied limbs cold, the breathing stertorous ; and death ensues. Such is the ordinary course of a fatal extravasation of blood into the ventricles, and such also are the successive phases of the disease when it occurs at the base of the brain ; yet, in most instances, may there be a symptom presenting itself, or conspicuous even by its absence, of special value in a diagnostic point of view.

Thus Dr. Tweedie relates an anecdote of being requested, by an eminent Scotch physician, to visit a mutual friend, who was represented as “dying the death of the blessed, deprived of all

sensorial functions." The patient, whose pulse was undisturbed and his limbs disabled, but not positively paralyzed, on being freely bled, opened his eyes, extended his hand, quietly said, "How d'ye do, Dr. Tweedie?" recovered, and lived many years after.

But paralysis is not necessarily the result of effused fluid into the ventricle, for a large quantity of serum has been found in some cases where no paralysis had occurred. When, however, blood is extravasated into the corpora striata or optic thalami, paralysis is the invariable result; and almost as invariably is the hemiplegia on the side of the body opposite to that in which the extravasation occurs. Andral has recorded some few exceptions;* but in not one instance is it stated whether the ordinary decussation fibres in the medulla oblongata were looked for.

Dr. Waters, of Liverpool, has described a very instructive instance of disease of the corpus striatum (*British Medical Journal*, May 4th, 1861).

CASE 41.—George Gibson, aged 43, a man of colour, cook on board a vessel, was admitted into the Liverpool Northern Hospital April 11, 1860. He had previously had an attack of pleurisy, from which he had recovered six weeks before his admission; and when under treatment for the pleurisy, he was profusely salivated by a single small dose of mercury. After this he felt weak, and eight or nine days before admission he began to feel a loss of power in the left arm and leg. This symptom gradually increased, and was attended with pain in the head.

There was no hesitation in his manner; he could speak distinctly, and answer questions readily and well. He gave a clear and intelligible account of the accession and progress of his symptoms, of which he seemed to think very lightly. There was almost complete paralysis of motion of the left arm and leg, the tongue was protruded slightly to the left side, and the mouth slightly drawn to the right. He could *close* both eyes, but was unable to *open* the right one fully. Sensation was perfect on both sides. He complained of pain over the whole of the left side of the head. The pulse was 50, and very laboured. He was ordered some decoction of aloes, a turpentine enema, and a little brandy. He continued in the condition above described up to the 14th, early in the morning of which day he was

* Op. cit., vol. ii., pp. 526—530.

found in a perfectly comatose state. At midday the pulse was 54, irregular and laboured. He could not be roused. He was breathing noiselessly; but when disturbed, stertor came on. He died at 3 p.m. of the same day.

AUTOPSY.—On removing the calvarium, the surface of the brain was seen to be somewhat pale. There was no fluid in the arachnoid. The brain-substance, with the exception of the parts mentioned below, was firm and apparently healthy. The right lateral ventricle contained a quantity of semi-fluid matter, consisting of disorganized brain mixed with blood. The walls of the ventricles were rough and flocculent, and marked with numerous vascular spots. The substance of the hemisphere around the ventricle, to the extent of a quarter of an inch in thickness, was softened so as to be readily washed away with a gentle stream of water. The right corpus striatum was softened and disorganized throughout, and effused blood was mixed with the broken-up brain-substance. The rest of the brain, including the substance of the optic thalami, was healthy.

It has been observed that loss of speech is a constant attendant on extravasation of blood into the anterior lobes of the cerebrum. MM. Lallemand, Rostan, and Bouillaud have described seventeen such cases, and fifty others in which the power of speech was retained with extravasation into every other part of the cerebrum.

An interesting case is recorded in the “American Journal of the Medical Sciences”^{*} illustrative of this fact.

CASE 42.—R. C., aged 16, was admitted into the Episcopal Hospital of Philadelphia, under Dr. Hunt, having been impaled in the left side of the head, through the frontal and parietal bones, by three iron spikes of a revolving rope-machine.

No brain symptoms were observed until the second day after the accident, when periodical delirium occurred, and, on the fourth day, hemiplegia of the right side supervened. Simultaneously with this, the patient had well-marked trismus of the right side of the face, with risus sardonicus, inability to open the mouth, hard abdominal muscles, involuntary jerking of the right leg, which the youth had not the power to restrain. The rectum and bladder were also paralyzed.

On the sixth day from the accident, tetanus was thoroughly confirmed by a remarkable combination of empros- and pleuros-thotonos—the body being bent forward and arched towards the left side, as

^{*} No. 89, New Series, January 1863.

though the paralyzed side had no power of resistance. Coma supervened, and death occurred on the ninth day.

On the fifth day the patient was unable to speak, *but his tongue was not paralyzed*. He was perfectly conscious, and when aroused his eye had an intelligent expression, not at all according with his inability to speak.

EXAMINATION.—Three punctured fractures of the cranium were discovered, and three rough fragments of the internal table of the skull projected inwards; the largest, about half an inch long from inside the frontal bone. The membranes and the brain were lacerated at points corresponding with the fractures. The left anterior lobe was the seat of a large abscess.

In this case the tetanus was manifestly the result of reflex action; and it is an interesting question, whether or not the loss of speech may depend on a loss of the connecting link between the vesicular matter which generates the thought and that which excites the tongue to action, rather than on a loss of the power of articulating them. Gall made the anterior lobe of the cerebrum subservient to language, and the question is argued with great ability in the “*Nouvelle Bibliothèque Médicale*” for 1826. The fact may assist diagnosis.

The distinguishing characteristic of cerebral paralysis is the loss of voluntary motion of the extremities, generally of one side, and that the opposite to the side of the brain in which the lesion exists; the arm being, in a marked degree, apt to be more affected than the leg. Although consciousness and sensation may be lost for a time, if the patient survive, those faculties for the most part return shortly after the attack. The muscles which minister to the function of respiration generally remain undisturbed.

In cases of unilateral atrophy of the cerebrum, hemiplegia of the opposite side of the body is the almost invariable result.* If the atrophy be imperfect, the paralysis is incomplete, and the arm is more affected than the leg.

When the cerebellum is the seat of extravasation, paralysis is not a necessary result;† but in many cases satyriasis is a premonitory symptom.

* “On Atrophy of the Brain,” &c., by R. Boyd, M.D.,—*Medico-Chirurgical Transactions*, vol. xxxix., p. 59—70.

† Mr. Dunn’s case of Apoplexy of Cerebellum, *ibid.* vol. xxxii., p. 105.

In cases, too, of atrophy of one hemisphere of the cerebellum, no paralysis has been observed.*

As the effect of extravasation into either crus cerebri, we should predicate hemiplegia of the opposite side of the body, and paralysis of the third nerve of the corresponding side; when the consensual movements of the two eyes would be destroyed, and partial ptosis of the affected eye produced. Such, in effect, were the symptoms observed in two cases which were brought before the Royal Medical and Chirurgical Society by Dr. H. Weber.†

In structural lesion of the pons Varolii, together with the hemiplegia which we should expect from extravasation in the course of the nerve-fibres conveying the mandates of the will from the brain to the spinal cord, the functions of the fifth pair of nerves are more or less implicated. The nerves, too, which regulate the state of the pupils seem to be in close connexion with the pons Varolii.

But it is when the medulla oblongata—the *nodus vitæ*, as Van der Kolk has called it—is the seat of disease, that respiration, sensation, and circulation are immediately affected, as in many cases they are by reflex action.

A further means of assisting our diagnosis in cerebral paralysis is the character of the pain. It has been observed that when a lesion is seated deep in the substance of the brain, there is no great intensity of suffering; whereas when the membranous coverings of the brain or the surface of the brain itself is the seat of morbid action, severe pain in the locality of the disease is an invariable concomitant.

The temperature of the surface is justly regarded with some degree of anxiety in severe cases of apoplexy; seeing that, when the extremities are cold, and the face pale and shrunk, if the pulse be irregular, there is great reason to fear that the ganglionic nucleus which is subservient to the action of the heart is implicated in the structural lesion.

The irritability of paralyzed muscles is also an interesting subject of investigation. The phenomenon was first examined with great care and ingenuity by Dr. Marshall Hall, who first

* Van der Kolk "On Atrophy of the Left Hemisphere of the Brain."

† April 28th, 1863.

made a distinction between the paralysis which results from lesion of the spinal cord, and that produced by lesion of the brain.* Assuming that the spinal cord, exclusive of the cerebrum, is the source of muscular irritability, and that the cerebrum is, in its acts of volition, an exhaustor of that irritability, he inferred, from various pathological cases and experiments,—1. That muscles separated from their nervous connexion with the brain have augmented irritability; and, 2. That muscles separated from their nervous connexion with the spinal marrow have, on the contrary, diminished irritability.

These views were favoured by the fact, which he had previously established, that there is a separate centre of nervous action in the spinal cord, and that numerous movements take place, the origin of which is, not in the brain, but in the spinal cord itself. Being performed unconsciously, as breathing is, and being organic responses to certain physical stimuli, transmitted to and reflected from the ganglionic centres in the spinal cord, they have received the name of reflex actions.

The chief objective sign by which Dr. Marshall Hall measured the irritability of paralyzed muscles, was the degree of contractility which followed the application of a very *mild* stimulus of galvanism by the Cruikshank's battery or trough; and in all cases of cerebral paralysis recorded by him, he found the irritability of the muscles of paralytic limbs greater than that of the muscles of the healthy limbs; whilst in cases of paralysis of the spinal cord and of disease in the course of nerves, the muscles of the paralytic limb were found to be less irritable than those of the healthy limb.

He was led to the contemplation of this subject by the interesting fact, first noticed by M. Fouquier, that when strychnine is administered to patients affected with paralysis, it is the paralytic muscles which first manifest the peculiar influence of the drug.† To the explanation, suggested by M. Ollivier, that the phenomenon was due to the action of the

* See Transactions of the Royal Medical and Chirurgical Society, vol. xxii.—“On the Irritability of the Muscular Fibre in Paralytic Limbs.” Also, under the head of “Irritability,” in the Cyclopædia of Anatomy and Physiology; and subsequently in the Medico-Chirurgical Transactions, vol. xxxi.

† “Mémoire sur l'Emploi de la Noix Vomique dans les Paralysies,” 1815.

medicine on the nervous centres, Dr. M. Hall subsequently objected, on the ground that the view was too general and too indiscriminate, seeing that it was not in every case of paralysis that strychnine would first display its influence on the paralytic muscles. No cases, however, are recorded in which the exceptions are shown; but two cases of paralysis of the facial nerve are described, in which the galvanic stimulus was made to pass through the fibres of the orbicularis palpebrarum, when the eyelid of the healthy side was affected, whilst that of the paralytic side gaped as before. In a case, however, of cerebral paralysis of the face and hemiplegia of the body, the same electric current affected the paralytic side more than the healthy one.

In the case No. 31 which I have described, one-twentieth of a grain of strychnia was given three times daily for six months, and the patient steadily improved; but after two or three days, a constant quivering motion of the right eyelid, of the lips, and of the surface under the chin, was observed. On two occasions the remedy was discontinued for three or four days, when the agitation of the paralyzed muscles ceased, but recommenced when the medicine was again taken.

To the ten cases related by Dr. Marshall Hall for the purpose of proving the truth of his theory, Dr. Todd adduced thirteen others to demonstrate that, in some morbid states of the brain, the irritability of the muscles of paralyzed limbs is not increased;* but as he used the electro-dynamic machine supplied with a single cell of Daniell's constant battery, the difference of results was attributed by Dr. M. Hall to the difference of apparatus. I have often repeated the experiment with a Cruikshank's battery, and with such varying results, that I am disposed to think that the greater contraction in the unsound than in the sound limb—when it is produced—is due to the restraint exercised by the will of the patient over the healthy limb, when it cannot be ascribed to irritation or inflammation of the brain.

* "Medico-Chirurgical Transactions," vol. xxx., pp. 210—217; and *ibid.*, vol. xxxvi., pp. 459—481. See also "Recherches sur l'Etat de la Contractilité et de la Sensibilité Electro-musculaire dans les Paralysies du Membre Supérieur, étudié à l'aide de la Galvanisation Localisée." Par le Dr. Duchenne (de Boulogne). Paris, 1850.

CASE 43.—A gentleman, aged 50, during a visit in Greece, where he was living somewhat freely, and taking long riding expeditions, awoke early one morning with a tingling sensation in the left arm and hand, which disappeared entirely in about ten minutes, but returned at precisely the same time the next morning with increased violence, and continued for the space of four days, when a sensation of numbness and weight of the left leg supervened; for which he was cupped, and the symptoms were relieved. About three weeks after, whilst dressing, he suddenly felt a fulness of the head, flushing of the face, and extreme weakness of both legs, but of the left especially. He was freely bled; an active aperient was taken, and in the afternoon he was again very much relieved. The sensations, however, of weakness and tingling never left him entirely. Some four months after, on his homeward journey, being drenched with rain and chilled, on his arrival at the Hospice at St. Gothard, the sensations of numbness and weakness of the left side were more strongly felt than they had been since the last attack. Two days after, on leaving his dressing-room, he found himself flat on the floor, with a gash at the corner of his left eye, from which blood was flowing copiously. His first impression was, that he had slipped; but he had no recollection of slipping. He was left, however, with his left arm partially paralyzed.

On his return to England, I employed Cruikshank's battery; the stimulus of which produced, at first, very slight contraction of the paralyzed arm as compared with that of the right side. In about two months he regained the entire use of the limb.

Dr. Marshall Hall's cases and experiments are unexceptionable in their way, and very suggestive in their effects; but the course of events is not so constant as he has described, and, therefore, cannot justify such an inductive generalization as to constitute a law.*

At the risk of being tedious, I have entered into these details, because the question is important in a practical point of view.

The rigidity of muscles, when it occurs at an early period of paralytic seizures, was fixed upon by Dr. Todd as an indication of irritative disease within the cranium,† and, as such, supplied

* The experiments which he performed on frogs do not prove his theory, but only show, what every physiologist admits, that volition is an endowment of the brain, and that, by dividing the spinal cord, voluntary motion is lost to all those parts which are supplied with nerves having their origin behind the division, whilst automatic motion alone remains.

† "Clinical Lectures on Paralysis," p. 31. See also Bayle's "Traité des Maladies du Cerveau," &c., p. 561.

him with an important practical inference in relation to treatment.

It is the very opposite to that form of cerebral paralysis in which the affected muscles are soft and flabby. In the first case the circulation of arterial blood in the diseased limb is vigorous, in the last it is weak; in the former no œdema is apt to supervene, in the latter it is of frequent occurrence; in the one the irritability of the muscular fibre is strongly manifested by the galvanic test, in the other the criterion proposed by Dr. Marshall Hall fails.

The flaccid muscles, however, often become stiff and contracted in length, diminished in volume, and hardened in substance; probably, in consequence of some change in the condition of the areolar tissue surrounding the elementary fibres: for, when examined under the microscope, the transverse stripes still appear; the sarcolemma preserves its integrity; but the areolar tissue is dense, as it is seen in muscles wasted by rheumatism, and thus seems to restrain motion between fibre and fibre, to press on the delicate capillaries and nerves which traverse the interstices of the fibres, and, consequently, to obstruct the current of blood, which is essential for healthy nutrition.

As time wears on, a further change takes place: the paralyzed muscles assume a yellow colour; but, to the unassisted eye, the muscular fasciculi appear to remain. The microscope, however, discloses a transmutation of the sarcous elements, and nothing remains but the fibrous tissue and fatty matter, composed of granules and oil-globules, which occupy the places of what was formerly muscular fibre.

The test which Dr. Marshall Hall proposed for the discrimination between cerebral and spinal paralysis has been adopted by Dr. Duchenne, of Boulogne, as a kind of myoscope, for the purpose of ascertaining the amount of muscular irritability, apart from nervous sensibility, which may exist in paralyzed muscles; and the result of his investigations is thus far applicable to diagnosis. In the first place, he determines that although lesions of the spinal cord and of the nerves proceeding from it *do* occasion the loss of muscular contractility, the beginning of the loss is perceptible only from about the second week after the injury; and, secondly, that in cerebral paralysis the palsied

muscles *do not* exhibit that difference which is observed between the affected and unaffected muscles in lead-palsy, which alone would justify the inference drawn by Dr. Marshall Hall,* except when irritation of the brain or of the meninges is the paralyzing cause.

But, in spite of all the general propositions which have resulted from the most careful observations of disease, and of experimental contrivances for unravelling the intricate fibre of the nervous centres, exceptional instances often present themselves to the physician which appear to qualify all such propositions. An attentive and sagacious observer, however, may generally detect a solution of his difficulty in arriving at a correct diagnosis, by the presence of some symptoms or the absence of others, or by some antecedent or concurrent circumstances; and it is much to be desired that the very interesting cases recorded by Dr. Abercrombie, in his "Pathological and Practical Researches on Diseases of the Brain and Spinal Cord," could be reconsidered by the light which the doctrine of reflex action confers on pathology at the present day. But, as they stand, they stamp that great and good man as a bright ornament to our profession; and were he again in the flesh, to revise his former opinions with the aid of a more perfect physiology, some of his cases would still justify the conclusion that "in the general pathology of paralysis there is much obscurity. We find it connected with a great variety of morbid conditions of the brain; and, on the other hand, we find all these existing without producing it. We cannot attempt to explain these difficulties, and must content ourselves with a simple view of the facts as they stand in the present state of our knowledge."†

We are encouraged, however, to hope for a better state of things; for it is precisely in those instances, which appeared to him to be the most unpromising instances in which paralysis occurred without the least deviation from the healthy structure of the brain, that the pathologist has discovered adequate causes for the disease.

* "Recherches sur l'Etat de la Contractilité et de la Sensibilité Electromusculaire," &c., p. 38.

† "Pathological and Practical Researches on Diseases of the Brain and Spinal Cord," 4th edit., p. 277.

In serous apoplexy, the oppression and stupor gradually lead on to coma, and the paralysis, when it results, comes on more slowly ; but even this diagnostic distinction may fail us in cases of extravasation where a minute vessel on the surface of either hemisphere is the source of a very slow hæmorrhage.

In each class of cases, the palsy, when present, is more affected by the seat than by the quantity of extravasated blood or effused serum. In serous effusion, the fluid is very often found in the ventricles, and the loss of speech, of the power of deglutition, and coma, are frequent accompaniments. It has been observed, too, that extensive paralysis may exist together with a very little effused fluid, and that a large quantity of fluid may be found in cases where no paralysis occurred : hence the growing belief that effusion into the cavities and palsy do not stand in relation to each other as cause and effect, but that both have a common centric cause, and, probably, of an inflammatory character. Palsy, I suspect, is more invariably caused by pressure and consequent degeneration of nervous structure produced by a transudation of serum from the capillary vessels into either the cellular or fibrous substance of the brain, which has been ably described by M. Durand Fardel as chronic softening.

PROGNOSIS.—“ *Isque morbus mediocris vix sanatur, vehemens, sanari non potest.*” Such was the opinion of Celsus ; and, after an experience of two thousand years, the opinion is endorsed by every modern practitioner. A great proportion of cases of apoplexy terminate fatally : hence the prognosis is, for the most part, unfavourable.

With respect to TREATMENT, if we except the aberrations of quackery, there is one remedy which has been universally adopted by all physicians in apoplexy ; and if the maxim of Hippocrates (rather with a view of preventing serious consequences than of removing them after they have come on) had ever been borne in mind, probably no remedy would have been employed with less modification.

The argument which has been used against it, founded on the assumption that no abstraction of blood can diminish the absolute quantity of that fluid in the brain, which is out of the influence of atmospheric pressure, is clearly a fallacy ; for the immediate effect of venesection is to contract the area of vessels, and thereby

to facilitate the restoration of the relative proportion between arteries and veins, and, so far, to relieve the excited action of the arteries of the brain. But M. Trousseau questions the tranquillizing effect of bleeding on an excited circulation, and, therefore, even in severe cases of apoplexy, seldom bleeds, on the plea that extravasation having occurred, it is difficult to see the good that bloodletting can do. "Extravasation in the brain," says he, "is like extravasation elsewhere; and no one would think of bleeding for extravasation of blood under the skin or mucous membrane. It would not facilitate absorption." Yet is it not denied that venesection diminishes the force of arterial action; and although it may produce what is called reaction of circulation, it is calculated to relieve congestion, which, M. Trousseau admits, may lead to cerebral hæmorrhage, and to prevent the further escape of blood when any has taken place. The propriety of bloodletting ought to be determined by the special circumstances of every individual case, and not by any general rule of treatment. If the pulse be full and strong, and there be nothing in the history of the case to contraindicate the operation, there can be no question as to its expediency. If, on the other hand, the pulse be small and irregular, and the surface of the body be cold, the remedy would be fatal.

The following is an apt illustration, and as such was made the subject of a valuable clinical lecture by Dr. T. K. Chambers:—*

CASE 44.—The patient, a housemaid, was always, by the account of her fellow-servants, quite well up to one morning when she was cleaning a grate, and fell down, entirely deprived of sense and motion. Two hours afterwards she was brought to the hospital, when she was still quite insensible and motionless. There was snoring breathing, the cheeks being so paralyzed as to be puffed out in expiration; the skin was livid and cold; the pulse weak, quick, and irregular. The pupils of the eyes were contracted partially, and insensible to light. She was placed in bed; hot bottles were applied to the feet and other parts of the body, and she had administered a stimulating purgative enema. Seven hours after the fit, the skin got warm; the pulse and heart beat strongly, and numbered 140 in the minute; and it was observed that the paralysis, though complete on the left side, was not so on the right. She was then bled to the extent of eight ounces from the arm; and four hours afterwards, another eight ounces

* "British Medical Journal," June 8, 1861.

of blood were taken from her. The pulse sank to 100. And she has since then recovered her senses and the use of her tongue, though not of her left side, or control over the sphincters.

And here I would refer the reader to four cases of apoplexy which were treated and described by Dr. Abercrombie,* who was an advocate for large and repeated bloodletting, active purgatives, and cold applications to the head, aided by an elevated position of the body, cool air, and the absence of all stimuli; and who, even in cases not generally considered as admitting of active treatment, yet pursued it and with good effect.

But, in spite of such authority, the practice of pursuing indiscriminately the antiphlogistic system of treatment in every case of apoplexy cannot be too much condemned. For instance, I would refer to a collection of 155 cases of apoplexy made by Mr. Copeman, of Norwich, of which the subjects of 129 were bled and 26 were not. Of the 129 bled, 51 recovered, and 78 died; or 1 in $2\frac{1}{2}$ recovered, and 1 in $1\frac{2}{3}$ died. Of the 26 not bled, 18 survived, and 8 died; or 1 in $1\frac{1}{2}$ recovered, and 1 in $3\frac{1}{4}$ died. Of the 129 bled, 85 were bled copiously and generally; of these 28 recovered, and 57, or 2 in 3, died. These statistics lead us to the rational conclusion that every individual case must be judged of and treated according to its special characters and symptoms.

It should always be remembered that the absorption of extravasated blood is a process which requires a certain amount of bodily strength, and a considerable space of time; and that, therefore, the paralysis which results from such extravasation demands a due regard for the inherent power of repair, and the exercise of a large amount of patience: for nature alone accomplishes this process much better and far safer than we can do it by strychnia, electricity, and other stimulants, which may be safely used in many other forms of paralysis, but which cannot be employed in the one under consideration without involving the risk of further extravasation.

When, however, every symptom of cerebral excitement has been subdued, both galvanism and strychnia may greatly assist in restoring motion and strength to the paralyzed muscles.

* "Pathological and Practical Researches on Diseases of the Brain," 4th edit., p. 289—291.

But the best of all tonics is a perfect holiday ; and for the full amount of benefit to be derived from such a change, I am persuaded that there is nothing like an alpine country. It is there that a bracing air communicates a healthy oxygenated character to the blood ; that passive exercise amidst a glorious scenery gives a *gaieté de cœur* such as no other physical agent is capable of, and assists the assimilation of a light, nutritious diet, to which the convalescent should be confined : in short, it is there that every moral and physical influence is combined to promote the absorption of a blood-clot, and restore vigour and motion to the enervated muscles.

Paralysis from Red Softening.

It sometimes happens that a sudden attack of paralysis is the very first expression of an existing disease, which a previous stage of impaired health and failing power may have threatened as an impending possibility.

Sometimes a slow but ceaseless progress of decrease in muscular strength, through its successive degrees, to a state of complete paralysis, corresponds with the progress of the inflammation of the brain. This is significantly called *creeping palsy*. Or, it may be, during the gradual diminution of voluntary motion, a sudden increase of paralysis is but too sure an indication of as sudden a rupture of the vessel in the brain, the effect of which is simply to hasten the inevitable end.

As a general rule, paralysis from red softening is progressive in character ; and in almost all cases contraction and rigidity of the paralyzed muscles are observed at the commencement of the disease. Sometimes periods of remission and exacerbation occur, which are obviously dependent on remission and exacerbation of cerebral disturbance.

I have at the present time a lady's maid under my care, two of whose aunts have died from softening of the brain.

CASE 45.—The young female in question, aged 18, having had all the premonitory symptoms of inflammation of the brain, became suddenly delirious. When I first saw her, the left pupil was more contracted

than the right ; her pulse, 130, was hard, full, and incompressible ; her tongue dry ; and she complained of intense headache, but of no very great intolerance of light. After general and local bloodletting, the latter consisting of twenty-four leeches around the anus (the menstrual discharge having been very much diminished in quantity for some two or three months before), the violence of the disease has been subdued ; but during the intervals of excitement her intellect is manifestly affected, and for the last week past, at irregular periods of time, paroxysms of delirium supervene, during which the flexor carpi radialis and the flexor pollicis longus of the left hand are evidently paralyzed and rigidly contracted, so that any attempt to extend the hand, the thumb, or even the index finger, causes great pain.

When the muscles of the face are implicated in the palsy, the same contraction and rigidity are observed in them as in the muscles of the extremities, and the mouth is drawn towards the palsied side of the body. In apoplexy the deviation is towards the healthy side.

Drs. Sibson and Handfield Jones have described an apparent exception to the above in a case of hemiplegia of the left side, where, in the first instance, the muscles of the arm were flaccid, but subsequently became rigid.* The affection, however, began as white softening, and inflammatory symptoms supervened.

Dr. Lallemand, of Montpellier, relates the following :—

CASE 46.—A man, aged 76, was found lying insensible on the floor of his room, with anæsthesia and loss of motion of the left arm and leg, both being semiflexed, contracted, and stiff ; but, notwithstanding the loss of sensation and motion, any attempt to extend either arm or leg was productive of pain. The patient's intelligence returned, to a limited extent ; but he sank into a semi-comatose condition, and died on the sixth day after the attack.

INSPECTION.—The arachnoid extending over the right hemisphere of the cerebrum was found covered with a thin layer of lymph ; the middle and posterior lobes were reduced to a condition of softening resembling pus, except the lower portion of the middle lobe which was of a brownish red colour from infiltration of blood. The capillaries were considerably dilated.†

CASE 47.—A gentleman, aged 44, who for many years had suffered

* "Proceedings of the Pathological Society of London," 1851-52.

† "Recherches Anatomico-Pathologiques sur l'Encephale et ses Dépendances," Lettre 2me, No. 1.

from intense headache, was seized in 1845 with an unusually severe attack, which left him with a sensible diminution of muscular power and sensation in the right leg. This weakness increased in degree with each attack of headache during a period of three successive years, when, after considerable mental labour, he suddenly lost the power of articulating words, and the right arm became partially paralyzed, so as to prevent him from writing, though not from using a stick or lifting a weight. Cupping behind the ears restored, to a certain degree, the power of speech; but the articulation of words continued imperfect and indistinct. Exactly five months after, on awaking from sleep, the thumb and forefinger of the right hand were found to be much more disabled, and the articulation more indistinct. Again cupping produced a very slight amendment; and during the two successive months my notes record six recurrent paroxysms of severe headache, each one leaving a perceptible impression on voluntary motion; and on each occasion a very slight relief was obtained from cupping, but never so much as to regain the lost ground. In June, 1849, the left leg became suddenly paralyzed, and the ability to articulate words still more curtailed. From this period of time the symptoms steadily increased, the paralysis extending gradually to the left arm, so that in November both arms and legs were perfectly paralyzed, and the faculty of speech so much affected that it was impossible to comprehend him. Thus he continued constantly losing power, until December, when he died, just four years and three months after the first manifestation of palsy.

No examination was allowed, nor was any needed to show that the brain was so changed in texture as to be unable to bear the quantity of blood sent to it. Still, it would have been a great satisfaction to ascertain the precise extent and progress of the disease.

In this case I occasionally used a Cruikshank's battery, the stimulus of which produced a far greater amount of contraction of the paralyzed muscles than of those which were unaffected.

The following very interesting example of ramollissement has been described by Dr. Calmeil:—*

CASE 48.—M. Clark, aged 49, after a luxurious but chequered life, and with no other antecedent disturbance of health than an attack of acute rheumatism which confined him to his bed for six weeks, some four years before, discovered that the right commissure of his lips was suddenly drawn down, and that his power of articulation was

* “*Traité des Maladies Inflammatoires du Cerveau*,” tome i., pp. 335—340.

occasionally impaired. These symptoms continued for about two months, when an attack of apoplexy supervened, together with a loss of sensation and motion, and a deviation of the mouth to the right side. After a few minutes sensibility returned, but great difficulty was experienced in articulating the final syllables of words ; and with the restoration of consciousness he recovered the power of locomotion and sensation ; but his gait became unsteady and tottering, and his intellect obscured. He was gradually regaining his faculty of speech and ability to walk ; but in the course of five months after the apoplectic seizure, his intellect had become manifestly weak, his memory defective, his temper irritable, and in all things he became fastidiously nice.

This condition was followed by hypochondriasis, during which his power of voluntary motion diminished gradually but steadily, and two months before his death he could neither stand nor sit. The act of deglutition, too, was, apparently, both painful and difficult, so that he would remain a long time with food in his mouth before he could be induced to make an attempt to swallow ; and when he did, the effort excited convulsive movements of the pharynx and face. At last he lost all control over his bladder, and his water dribbled away unconsciously ; his speech grew more and more indistinct, and his respiration became embarrassed : but this latter was the result of pneumonia and pulmonary congestion, of which he died sixteen months after the first symptoms of paralysis.

On *inspection*, the cavity of the arachnoid contained a considerable quantity of serum ; the pia mater was opaque in patches, infiltrated by serum, and very adherent to the cerebral hemispheres ; the grey substance bloodshot (*éraigée*), especially towards the fissure of Sylvius, where the cortical substance was converted into a violet-coloured pulpy mass. All the cerebral commissures were soft, as was also the cortical layer of the cerebellum, and the grey matter of the pons Varolii and medulla oblongata.

Under the microscope, a portion of the softened and discoloured grey substance was seen to contain numerous dilated capillaries, with their surfaces sprinkled over, as it were, with greyish granules ; and here and there along their course, a collection of brownish cells and an appearance of cloudiness was remarked, due to the extravasation of the colouring matter of the blood. In every portion of the grey substance, especially in the corpora striata, these appearances excited the attention of the observers. In the white or fibrous parts of the brain, the capillaries presented the same dilated and engorged condition.

The application of the microscope to these particular cases was of great practical use ; for it proved the truth of Dr. Lallemand's theory, that the pathological change which is known as red softening is essentially a capillary hæmorrhage into the surrounding substance of the brain, and that the only difference between it and the blood-clot in apoplexy is that the extravasated blood is infiltrated into the cerebral substance, with which it is intermixed in the one case, whilst it forms for itself a cavity, and exists as a mass or clot, in the other.

There is another circumstance of great interest in Dr. Calmeil's case, especially when considered in connexion with congenital imperfections of the brain. I allude to the softened condition of the cerebral commissures.

A decussation of nerve-fibres between the two lateral halves, is the great principle on which the cerebro-spinal axis is formed ; and, whether it be for motion or sensation, an interchange of function is essentially necessary.* May not the same correlation of structure and function be an indispensable condition of a sound mind ? and if so, may we not, in some cases at least, regard a settled or progressive dementation as a diagnostic sign of structural degeneration of the cerebral commissures ? There is no tabulation of instances to give authority to this view, and there is one circumstance to allege against it, namely, that the same disordered intellect may be produced by softening of either cerebral hemisphere ; so that, in truth, we have no special indication to offer as a guide to localize the seat of lesion.

Dr. Abercrombie relates two cases† in which there was ramollissement of the fornix and of the septum lucidum, producing incoherence but no palsy.

We know that the same parts of the brain which are most liable to be affected by apoplexy, are also most obnoxious to morbid softening : hence, in our present state of knowledge, our judgment is not unreasonably influenced by tables such as Andral has produced. But it should never be forgotten, that as

* Even the trigeminus, which is generally regarded as a one-sided nerve, decussates with its fellow of the opposite side. See Van der Kolk, plate v., fig. 11, *g*.

† See cases Nos. 41 and 58.

to the inexperienced observer half the evils that afflict our frame produce no outward sign, so may the clue be still concealed by which the sagacious physician may one day ascertain the seat and progress of many brain diseases; and the phenomena which present themselves in cases of imperfect development are not unlikely to assist in the discovery.

Now, in all such cases as have been reported, there appears to have been a defective intellect, less marked, perhaps, in the instance described by Mr. Paget* than in any other; but in that particular case the corpus callosum was not entirely absent, for a cylindrical cord (a rudimentary corpus callosum) extended from one hemisphere to the other, and the peculiarity of mind was "vivacity and want of caution, showing themselves in an habitual rapidity of action, and want of forethought, deliberation, and attention." In three other cases, described in the same paper, the cerebral commissures were still more imperfect, and the intellect still more obtuse. Mr. Mitchell Henry has also recorded a case† somewhat similar to Mr. Paget's, the corpus callosum and fornix being not entirely absent; but instead of the vivacity displayed in the one, the other "exhibited rather a sluggishness than an actual deficiency of mind." In neither was there any paralysis of voluntary motion. A sixth instance of a similar imperfection has been recorded by Dr. Down,‡ in which the corpus callosum and fornix were imperfectly formed, and the septum lucidum and commissura mollis entirely absent; and it is worthy of notice that in both Mr. Paget's and Mr. Henry's cases the "fibres of the imperfect corpus callosum passed forwards and downwards into the substance of the anterior lobes," whilst in Dr. Down's case "the inner surfaces of the anterior lobes of the cerebrum

* An Account of a Case in which the Corpus Callosum, Fornix, and Septum Lucidum were imperfectly formed, by James Paget, F.R.S., &c.—"Medico-Chirurgical Transactions," vol. xxix.

† "Description of the Dissection of a Brain in which the Corpus Callosum, Fornix, and Septum Lucidum were imperfectly developed." By Mitchell Henry, House Surgeon to St. Bartholomew's Hospital.—"Medico-Chirurgical Transactions," vol. xxxi.

‡ Account of a Case in which the Corpus Callosum and Fornix were imperfectly formed, and the Septum Lucidum and Commissura Mollis were absent, by J. Langdon Down, M.D.—"Medico-Chirurgical Transactions," vol. xlv.

were separated inferiorly as far as the anterior commissure ; and the parts of them into which the knee and reflected portion or rostrum of the corpus callosum are usually inserted, were covered with convolutions such as are common to other parts of the corpus callosum. Coincident with these abnormalities, there was defective intellect in all ; but in the two first cases in which a few commissural fibres served to unite the anterior lobes, the patients could read and speak with freedom ; whereas in the last case, the boy, "on seeing any lady in black, the colour usually worn by his mother, would approach, and, after examination, would say, "*No mamma! no!*" which with the word "*me,*" when he wanted anything, were the only words he could utter.

These, again, are circumstances which suggest the idea of a gap in the fibres of communication between the intellect which is competent to shape the thought, and the nucleus of the hypoglossal nerves which excite the tongue to action.

Dr. Down attaches importance to the absence of the soft commissure, as a cause of the *extreme* mental deficiency in his patient.*

The characteristic signs of paralysis, as resulting from red softening of the brain, are—1. Its disposition to affect the middle-aged rather than the very old ; 2. The existence of premonitory symptoms which threaten the impending palsy ; 3. The rigid and contracted condition of the paralyzed muscles ; and, 4. The steady progress of every symptom, from one stage to another, without the cheering influence of returning sensation, when it is once lost, which generally occurs in apoplexy ; but, step by step, one uniform and progressive increase and aggravation of every brain-symptom stamps the nature of the disease, and deprives the patient of sensation and motion, but not necessarily of consciousness until death puts an end to all.

As a rule, it may be stated that when with a sudden attack there is loss of consciousness and sensation, when the patient sinks rapidly into coma there is extravasation of blood into the hemispheres of the cerebrum ; but when, on the contrary, the

* Dr. Todd has suggested that the corpus callosum may be the medium by which the double organic change is made to correspond with the working of a single mind. See "Cyclopædia of Anatomy and Physiology," vol. iii., p. 723 D.

attack of paralysis is sudden, and the consciousness not lost, it may be inferred that it is a case of ramollissement.

Of the *prognosis* in red softening of the brain, it may be said to be a far more serious affection than simple apoplexy, for it involves a larger portion of the brain, and as the red colouring matter of the blood disappears, the nerve fibres, in the interstices of which it was infiltrated, are broken up, and their continuity as conducting agents is destroyed.

The progress of inflammatory softening is generally rapid. The first stage, it is true, may appear to be somewhat stationary; but when softening has once begun, the progressive increase of the paralysis is very rapid, terminating sometimes in five or six days.

In the *treatment* of this form of ramollissement, the principal indication is to reduce the violence of arterial action, and thereby to prevent the further escape of blood; but the antiphlogistic measures employed for such purpose should, of course, be modified according to the circumstances of the case. In that numbered 47, for instance, no remedy alleviated each successive advance of the disease so much as the cupping and abstraction of a small quantity of blood from behind the ears; whilst in that numbered 45, the leeches applied to the perinæum subdued the excitement of the brain more than did the general venesection. In the absence of actual cerebritis, mild, unstimulating tonics are perfectly consistent with bloodletting, and often appear to be of great service in arresting the rapid progress of the disease. The sulphate of zinc is, I think, a safer remedy in these cases than any preparation of iron.

But in no form of disease is the maxim that "prevention is better than cure" more forcibly apparent than in ramollissement of the brain. In many instances, too, premonitory symptoms forewarn us in time of the approaching malady; and then it is that such a holiday as I have suggested for the reparation of the mischief inflicted by apoplexy may be attended with success. But, alas! how frequent it is that the canker-worm of care from pecuniary embarrassment is set forth as the cause of the failing health, and that we are bid to do our best under such adverse circumstances!

Paralysis from White Softening.

Paralysis is very often dependent on a softening of the brain, which results from a cause the very opposite in its nature to that of inflammation.

Any casualty which deprives the brain of its healthy supply of blood is capable of producing this particular softening.

M. Rostan, who was the first to call attention to ramollissement of the brain, regarded all forms of the disease as the result of the above cause, and traced an analogy between it and gangrena senilis. As physician to the Salpêtrière, where by far the majority of the patients are very old women, he often observed the vessels of the brain occluded by ossific and other deposits; and as softening of the organ was an invariable concomitant, he naturally concluded that in all cases the disease was dependent on the same cause.* We have seen, however, that in red softening such is not the case.

When an artery of the brain is greatly diminished in calibre, or closed by embolism, or by ligature for aneurism, or by tumours, or any other accidental causes, that portion of the brain which depends for its supply of blood on the vessel so closed degenerates into a soft, pultaceous substance resembling pus, and so passes into a state of white ramollissement. In the softened condition the specific gravity of the cerebral substance is lower than that of healthy brain in the proportion of 1039 to 1046, which Dr. Bucknill attributes to inert molecules replacing the active cerebral material.†

The following cases are illustrative of these observations, and of the various modifications of paralysis induced by the morbid changes:—

CASE 49.—J. A., aged 75, was admitted into the infirmary of the Hospice des Incurables at Paris, in January, 1858, for a partial blindness, of which he was considerably relieved, when, on the morning of the 10th of March following, he suddenly lost the power of

* “Recherches sur le Ramollissement du Cerveau.”

† See “Lancet,” Dec. 25th, 1852.

speech. His face became dull and stupid, the angle of the mouth drawn towards the left side, the muscles of the right side being paralyzed; and he was unable to protrude the tongue. Towards evening paralysis of the right extremities crept on, but without any loss of sensation; and thus the patient continued until he died at midnight on the 12th.

On *examination*, thirty-six hours after death, the left *arteria cerebri media*, and its branch, the choroid artery, were found considerably diminished in calibre, in consequence of atheromatous and bony deposits in their coats; and they were rendered perfectly impervious by yellow fibrinous clots in their interior. The *hippocampus major* (*cornu ammonis*) was reduced to a semi-fluid substance, and that portion of the middle lobe in the immediate neighbourhood was also softened. The coats of the corresponding arteries on the right side were slightly thickened, but all the other parts of the brain were healthy.*

The following interesting case of embolism is recorded by Dr. Senhouse Kirkes:—

CASE 50.—Margaret Shaw, aged 34, a pale, weakly-looking woman, was admitted into St. Bartholomew's Hospital, under Dr. Roupell, about the middle of July, 1850, on account of pains in her lower limbs and general debility. A loud systolic murmur was heard all over the cardiac region. No material change ensued in her condition until August 7th, when, while sitting up in bed eating her dinner, she suddenly fell back as if fainting, vomited a little, and when attended to was found speechless, though not unconscious, and partially hemiplegic on the left side. The hemiplegia increased, involving the left side of the face as well as the limbs, and gradually became complete in regard to motion, while sensation seemed to remain unimpaired. She continued speechless and hemiplegic, but without loss of consciousness, for five days, when she quietly died.

On examining the body, six hours after death, the skull and *dura mater* were found natural; but the small vessels of the *pia mater* were much congested, the congestion amounting in some places almost to *ecchymosis*. The right *corpus striatum* was softened to an extreme degree, being reduced to a complete pulp of a dirty greenish-white tint, and without any remains of its characteristic striated

* The above case is reported by M. Lancereaux, in a treatise entitled "*De la Thrombose et de l'Embole Cérébrales considérées principalement dans leurs Rapports avec le Ramollissement du Cerveau*," pp. 82, 83.

structure. The corresponding optic thalamus was healthy; but a condition of pale softening, similar to that affecting the corpus striatum, existed also to a considerable extent in the posterior lobe of the right cerebral hemisphere. The rest of the cerebral substance of this hemisphere was softer than natural, and appeared to contain less blood than ordinary. All other parts of the brain were healthy. The right middle cerebral artery just at its commencement was plugged up by a small nodule of firm, whitish, fibrinous-looking substance, which, although not adherent to the walls of the vessel, must have rendered its canal almost, if not quite, impervious. With the exception of a speck or two of yellow deposit in their coats, the rest of the vessels at the base of the brain were healthy and filled with dark blood.*

In these two cases death evidently resulted from softening of the brain; and the cause of the softening was, doubtless, an inadequate supply of blood, consequent on obstruction of the middle artery of the cerebrum.

If the anterior lobe be in any way subservient to speech, disorganization of the hippocampus major should, in some degree, be attended with the same result as is observed in a similar lesion of the anterior lobe, seeing that the so-called internal convolution of the cerebrum is a longitudinal commissure connecting the anterior lobes with the hippocampus, and, may I add, maintaining a physical relationship between the sources of intellectual action and volition? The direction and disposition of its fibres is favourable to such hypothesis.

When embolism occurs in the capillaries of the brain, the structural lesion which ensues is shown by patches of softening which vary in size, but they are never so large as the softened masses which result from obstructed arteries. An instance of this occurred to Dr. Todd before the nature of the affection was well understood; but his delineation of the case is so perfect that it may be quoted as an example.

CASE 51.—A gentleman, aged 37, after walking hastily to his dinner, was seized, while eating it, with a fainting fit, from which he

* "On some of the Principal Effects resulting from the Detachment of Fibrinous Deposits from the Interior of the Heart, and their Mixture with the Circulating Blood." By William Senhouse Kirkes, &c.—"Medico-Chirurgical Transactions," vol. xxxv., p. 281.

quickly recovered, but complained loudly of a violent abdominal pain and nausea, with pain in the back. On the following day the urine became scanty, and the patient was drowsy and heavy-looking, as though he were labouring under an oppressed and sluggish brain ; the right pupil being manifestly larger than the left. During the afternoon of the third day, paralysis of the left side of the face supervened, with hanging of the cheek, depression of the left angle of the mouth, and sluggishness of expression on that side of the face. He protruded his tongue readily, but it deviated to the left side. The left upper and lower extremities were also imperfectly paralyzed. Sensation was not affected, but reflex actions could not be excited in the upper or lower extremities. The pulse was good on the left side, but on the right it was small and feeble, and the first sound of the heart was accompanied with a bellows sound. On the fourth day, the facial palsy seemed to be somewhat less complete, but the paralysis of the arm and leg increased. During the next six days, the hemiplegia diminished to a slight extent, so that he recovered some power over the arm, and the tongue was put out straight. There was a constant tendency to sink, however, and the patient died on the eleventh day.

On *examination*, thirty-six hours after death, the face and head appeared exsanguineous, the membranes of the brain decidedly paler on the right side than on the left. The vessels of the circle of Willis were pale and empty ; the right carotid and its branches were especially so. When the hemispheres of the brain were cut into, the bloodless state of the right hemisphere was very manifest ; and on examining the cut surface of the centrum ovale, it seemed as though it were worm-eaten in patches ; each patch being softened, so as to be broken up when a stream of water was poured upon it. The patches were numerous throughout the hemisphere above the fissure of Sylvius. The right half of the fornix and septum lucidum was soft, and the grey matter of the right side was pale. The right half of the choroid plexus was paler than the left. The part of the right hemisphere below the fissure of Sylvius was paler and softer than natural, but it did not exhibit the patches.*

We have here a subject for any amount of consideration, and of satisfaction too, in the precise agreement manifested between the symptoms as they appeared during life, and the pathological changes as they were disclosed in the examination of the body.

* “Account of a Case of Dissecting Aneurism of the Aorta, Innominata, and Right Carotid Arteries, giving rise to Suppression of Urine and White Softening of the Brain.” By R. B. Todd, M.D. —“Medico-Chirurgical Transactions,” vol. xxvii.

1. The seat of the aneurism, involving not only the internal carotid, but the vertebral artery also; the one supplying the internal carotid plexus of the sympathetic with blood, and the other the medulla oblongata before uniting with its fellow of the opposite side to form the basilar artery. 2. The excited circulation, which appeared to occasion the attack by detaching shreds of the fibrinous lining of the aneurismal sac, and carrying them to the minute vessels of the brain, and also, perhaps, into the arteriæ medullæ spinalis, thereby producing the sudden pain in the back, whilst probably a larger portion of the coagulum was conveyed to the abdominal aorta, to which the abdominal pain was doubtless attributable. 3. The trifling diminution of the paralysis, as the right side of the nervous centres may have received a little blood from the arteries of the left side. 4. The demonstration it affords of the decussation of the roots of the facial nerve in the raphe of the medulla oblongata: and, finally, the bloodless state of the right hemisphere of the cerebrum, associated with the drowsy, heavy look, as though the patient were labouring under an oppressed and sluggish brain, illustrative of the analogy between syncope and apoplexy. All these considerations crowd on the mind in the recital of the above case, and suggest an obvious explanation of every symptom.

Paralysis, as I have observed, may be caused by the application of a ligature to the carotid, and the softening of the brain which sometimes ensues.

CASE 52.—James Mason, aged 48, was admitted into St. Bartholomew's Hospital with an aneurismal tumour under the right ear. It had been eight months forming. On the 18th of July, 1829, the common carotid was tied for it; and an hour after the operation he was slightly convulsed on the right side, and soon sank into a state of stupor, with the mouth drawn to the *right* side. Muscular twitchings on the right side continued for the four following days; and on the fifth day the left side was perfectly motionless. On the sixth day (24th) the patient died.

The *examination* after death revealed the whole of the right hemisphere of the cerebrum in a soft and cream-like condition. The cerebellum healthy.*

* "Two Cases of Disease of the Brain following the Application of a Ligature to the Carotid Artery." By John Vincent, Surgeon to St. Bartholomew's Hospital. — "Medico-Chirurgical Transactions," vol. xxix.

CASE 53.—A second case is recorded, in the same paper, by Mr. Vincent, after tying the right carotid of a man, who in falling thrust a portion of a pipe which he had in his mouth through the side of the root of the tongue into the carotid artery at the point of its bifurcation. From the time of the operation it was observed that the patient did not move his left side until he died, eleven days after, when, in the right hemisphere of the cerebrum, several irregular-shaped cavities filled with an ash coloured effusion, with shreds and particles of a greenish hue, were discovered. One of these cavities was two inches in diameter, and encroached on the corpus striatum.

Professor Sédillot, of Strasburg, tied the right common carotid, immediately after which an alternate paralysis of the right side of the face and left arm and leg occurred. On examining the body after death, the right hemisphere of the cerebrum was found softened, but there was no disease of the pons Varolii.*

CASE 54.—A somewhat similar accident is described by Mr. Nunneley, of Leeds, who tied the left carotid of a woman for aneurism of the orbit. At the very instant of tightening the ligature, there was some convulsion of the left side, while the right was motionless. There was also partial unconsciousness, with sighing, and an appearance of nausea and faintness, evidently more from the condition of the brain than of the heart, for the pulse remained nearly natural. The patient rallied, however, on the following day, but still she experienced difficulty in swallowing and talking; and on the 7th day after the operation she had gained a little power in the right hand. The paralysis generally was said to be improved on the ninth day; but she continued restless, her mental condition being described as more resembling insanity than anything else, as she appeared to understand what was said to her, but to be incapable of replying. On the fourteenth day after the operation, the paralysis had obviously increased, for she was constantly drawing attention to her right arm by taking hold of it and lifting it up with the left hand. Two days after, she died.

On *inspection*, the brain was very pale in colour, with unusually little blood in its substance or larger vessels; but, as far as could be judged, the quantity was the same on both sides of the cerebrum and cerebellum. Both carotid and vertebral arteries everywhere, even in the smaller branches, patulous and studded with earthy deposits; the choroid plexus bloodless, white, and soft; the right

* “Gazette Médicale de Paris,” 3 Septembre, 1842.

hemisphere of the brain firm and natural; the whole of the left decidedly soft; and in the lower part of the middle lobe, just by the side of the sella turcica, and above the entrance of the carotid artery, there was a patch of the size of a large hazel-nut, quite soft and broken down. Here the left carotid, on emerging from the bony canal at the origin of the ophthalmic artery, was decidedly enlarged, filled with and surrounded by a nodule of coagulum of the size of a large horse-bean.

The patulous and ossified condition of the smaller branches of the carotid and vertebral arteries was an effectual obstacle to the resilience of vascular tissue, which is necessary for the establishment of a collateral circulation; hence the morbid results which followed the cutting off of the supply of blood to the left side of the brain; but the temporary rally on the day after the operation was a manifest indication of an effort to that end, notwithstanding the hindrance.

The causes of arterial embolism may be traced to some morbid state of the valves of the heart, or to some point between the capillaries of the lungs and those of the brain. One case is reported by Dr. Vidal in which embolism resulted from cancerous matter which was carried in the stream of blood from the lungs by the pulmonary veins through the heart, and thence to the brain.*

When paralysis occurs suddenly and sensation remains undisturbed, when the intellect is implicated and a period of amendment is observed, it may be inferred that embolism exists in one or more of the branches of the internal carotid artery, and that the emboli, or plugs, are in the side of the brain opposite to that of the body which is paralyzed. But when the paralysis is progressive and sensation is destroyed, when the intellect is less disturbed and indications of amendment are less manifest, especially if sickness or vomiting be present, it may be inferred that the emboli exist in the branches of the vertebral arteries. In both cases the paralyzed muscles are relaxed, but the electro-muscular contractility is retained.

When hemiplegia is occasioned by thrombi or fibrinous plugs in the venous system, it is always progressive in form, and

* "Comptes Rendus des Mémoires de la Société de Biologie," 1861.

almost always occurs in old people. It has, moreover, its own specific character; for when the circulation of the blood is obstructed in the sinuses of the skull, the periphery of the brain, and consequently the intellect, is more particularly implicated than the central parts which are affected in embolism.

In all cases of embolism the prognosis is bad, and the treatment of little or no avail. Large doses of the carbonate of ammonia have been proposed, on the assumption that the fibrine of the blood is held in solution by the presence of ammonia.

Paralysis from Induration.

The same exudation and transmutation of plastic lymph which has been described as increasing the consistence of the spinal cord may likewise produce sclerosis of the encephalon, together with the various affections of motion, sensation, and intellect which occur in œdema or softening of the brain.

This form of induration is generally the result of chronic inflammation; but an opposite condition of the intra-cranial substance is recognized by pathologists as resulting from great and exhausting exudations in other parts of the body; such, for example, as frequently occurs in the course of typhoid fever, or after scarlatina, when the brain substance, like other tissues, may be drained of its fluid element, and become hard and tough.

The minor degrees of increased consistence may not be incompatible with functional activity; but when the disease exists in an intense form, it is associated with some or all of the symptoms above alluded to.

Professor Schröder Van der Kolk has described many cases to show that induration of the corpora olivaria renders the articulation of words, the deglutition of food, and the acts of respiration difficult;* that induration of the cerebellum may destroy the power of co-ordination of muscles in the various movements of the limbs.† Paralysis, however, may not exist in

* Op. cit., illustrative cases, from p. 156 to 169.

† Ibid., p. 161.

such cases,* and Dr. Calmeil has shown in many cases† that affections of motion or of the intellect are very much dependent on the portion of the cerebral hemispheres which may be involved in the structural change. He has shown, too, in one remarkable case of inflammation of the anterior lobes, a corresponding fecundity of ideas and voluble speech in the early stage; but as induration crept on, the ideas became less prolific and the speech less fluent, until at last words failed the patient altogether.‡

But it must be confessed that, in the present state of our knowledge, we possess no means of distinguishing induration from ramollissement of the brain. We except, however, those cases which result from exhaustive processes of exudation, as in typhoid fever and scarlatina, in which certain indications of cure suggest themselves; and in all others, as the causes are the same, so also will be the indications for treatment.

Paralysis from Tumours, &c.

I have a strong conviction that a careful study of individual cases of tumours of the encephalon, and of all that has been written on them, will disclose a great uniformity of symptoms, and enable the practitioner, in the great majority of instances, to refer these adventitious masses to their particular seat in the brain. It is curious, however, to observe how the brain will accommodate itself to the bulk of these products without inducing paralysis; although many other symptoms testify to the existence of injurious pressure and irritation.

Many of the cases described by Abercrombie may be quoted in illustration, especially those numbered 6, 87, 90, and 91, in which no paralysis appeared.

The following, in which paralysis did occur, is recorded by Dr. Mayne.§

* "Cours de Pathologie," Andral, tome ii., p. 602, 2nd edit.

† "Traité des Maladies Inflammatoires du Cerveau."

‡ That of M. Laurent, tome i., p. 434.

§ "Acute Softening of the Medulla Spinalis: Tumour in the Medulla Oblongata." By Robert Mayne, M.D., Physician to the Adelaide Hospital, Dublin.—See "Dublin Hospital Gazette," May 15, 1861.

CASE 55.—A. B., aged 21, had always had good health, except a brief rheumatic attack in his eighteenth year. He had been at work constantly up to the evening of the 10th December, 1860, when, on returning home after a hard day's work, he was suddenly seized with an acute pain shooting down the left thigh and leg to the ankle and foot. He was compelled to stop abruptly in the street, feeling unable to proceed : a short time after, he made an effort to walk, and he then experienced a similar darting pain through the entire length of the right limb, so that he could scarcely move. With much difficulty he managed to reach his home and get to bed, when he was seized with a severe rigor. Subsequently he fell asleep and obtained some rest ; but on awakening in the morning he was paralyzed in both lower limbs. The bladder was paralyzed from the commencement. He was then received into St. Vincent's Hospital (12th December), and placed under the care of Dr. Quinlan. All power of voluntary motion in the lower extremities was gone, and there seemed to be complete destruction of the excito-motory phenomena as well. The tactile sensibility of the paralyzed limbs was much impaired, but not quite destroyed. There was complete retention of urine. Dr. Quinlan considered the case to be one of acute softening of the spinal cord : indeed, all the phenomena of the case seemed to confirm this opinion. The integuments over the sacral region soon became livid and sloughed, and the urine quickly became ammoniacal. By degrees the paralysis extended upwards ; and at length the left arm lost its power of motion in a great measure, and its tactile sensibility partially. After being a month in the hospital, sloughing of the integuments set in wherever the body was subject to the least pressure. There was fearful sloughing of the integuments over the sacral region and hips ; the trochanters on each side, and the osseous structure of the sacrum, were laid bare : yet, in the midst of this frightful destruction of parts, the patient suffered no acute pain, and was unconscious of his terrible condition. All power was lost over the bowels and bladder, the feces passed involuntarily and insensibly ; an insufferable odour pervaded the atmosphere around him ; the left arm was completely paralyzed, the right was partially so. He died on the 12th of February.

As there was difficulty in obtaining a post-mortem examination, the brain was not inspected ; but on laying bare the vertebral canal, the theca vertebralis seemed healthy at its exterior, its inner surface appeared congested and of a pinkish hue. On slitting up the pia mater, the spinal cord throughout the entire length of the dorsal region was found to be reduced to the consistence of cream and to be coloured red.

A tumour about the size of a small kidney-bean, of an oblong shape,

and hard as cartilage, was founded embedded in the left half of the medulla oblongata.

It is remarkable that no reference is made to any loss of speech, embarrassment of breathing, paralysis of the face or disturbance of stomach, which so large a substance in the medulla oblongata should produce; but as it was impossible to examine more of that organ than could be scooped out of the foramen magnum, perhaps the tumour may not have been located quite so high up. Very different is the case from Professor Oppolzer's "Klinik," quoted by Van der Kolk,* in which a lardaceous tubercle, of the size of a pea, had penetrated into the superficial substance of the right corpus olivare, producing loss of speech: and in no other case that I am aware of, except Dr. Mayne's, has the medulla oblongata been pressed on by tumours developed either in its interior or on its outer surface without the occurrence of a combination of symptoms clearly indicating the seat of lesion. When in the interior, and the adventitious matter presses on the nucleus of a nerve producing facial palsy, this latter is on the same side as the paralysis of the extremities; but if the tumour be on the outside, and the nerves proceeding from the medulla be pressed on, then the facial paralysis shows itself on the side of the head opposite to that of the hemiplegia of the limbs.

CASE 56.—A man, aged 36, had occasional paroxysms of acute headache, the pain generally shooting from the occiput to the forehead. In the course of a few months diplopia came on, and the left eye was drawn inwards towards the nose. Paralysis of the right side crept on by degrees, together with distortion of the mouth, the angle being drawn upward towards the right side, and the speech became inarticulate. Two months after the paralysis first showed itself, the patient became convulsed, and died in twenty-four hours.

On *examination*, a tumour the size of a hazel-nut was discovered on the left side of the pons Varolii, sinking deep into it. It extended backward to the side of the medulla oblongata, and pressed on the left corpus pyramidale, and also on the sixth or *abducens* nerve.†

* Op. cit., p. 160, note §§.

† "Case of Hemiplegia from a Tumour in the Brain, with Remarks on the Propagation of Nervous Influence." By J. Yelloly.—"Medico-Chirurgical Transactions," vol. i., p. 183.

A somewhat similar case is reported by Dr. Friedreich,* in which a tumour, the size of a pigeon's egg, developed from the dura mater, pressed on the left side of the pons Varolii, reducing the trigeminus, the facial, and the acoustic nerves to mere filamentous bands. Headache, deafness, and facial paralysis of the left side, together with hemiplegia of the extremities of the right side of the body, resulted; and the patient died, like Dr. Yelloly's, in a state of general convulsion.

Mr. Dixon has recorded a very interesting case, in which a large tumour was developed in the fifth nerve and the casserion ganglion, on the left side of the pons Varolii, producing anæsthesia of the left side of the face, and, by pressure on contiguous nerves, a total loss of all the special senses.†

I would also refer the reader to a case of tumour in the posterior lobe of the left hemisphere of the cerebrum, &c., associated with headache of the same side, a fixed and rigid condition of the upper extremities and paralysis of the lower, together with a drawn and fixed state of the muscles of the face, described by Mr. Duncalfe, of West Bromwich,‡ as worthy a careful study.

Tubercle of the Brain is a disease of childhood and youth, and it is always characterized by symptoms of irritation; hence the paralyzed muscles will generally be found in a contracted state. It is also always a chronic affection when developed in the brain, but it rarely undergoes the process of softening, although the portion of brain immediately surrounding it may be softened before it leads to a fatal termination.

After many years of careful observation, Dr. Gendrin concluded that tubercles in the medulla oblongata are apt to produce epileptic fits of regular recurrence, commencing generally with hiccup, difficult deglutition, and sometimes with palpitation, but never preceded by epileptic vertigo.§

In twenty cases of tuberculosis of the cerebellum, collected by

* "Beitrage zur Lehre von den Geschwülsten innerhalb der Schädelhöhle," Beobachtung vi.

† "Medico-Chirurgical Transactions," vol. xxix., p. 131.

‡ "British Medical Journal," Jan. 12, 1861.

§ "Recherches sur les Tubercules du Cerveau et de la Moëlle Epinière," 33, 34.

M. Andral,* paralysis occurred in eight; obstinate vomiting in ten; blindness in seven; affection of the genital organs in one only: but in all, the symptoms were suggestive of the seat and nature of the disease.

CASE 57.—M. Vulpian relates the case of a lad, aged $15\frac{1}{2}$ years, who was admitted into the Hospital St. Eugénie, having been ill during the two previous years.† He had had violent attacks of headache; strongly-marked amblyopia, which diminished after a certain time; and eventually a manifest loss of power in the extremities. Three months before his admission, vomiting occurred every morning. On entering the hospital, the violent pain existed in the back of the head; there was almost complete amaurosis of the left eye, the vision of the right being pretty good. There was also paralysis of the right side of the face, deviation of both eyes towards the left, loss of power in the right arm and leg, vertigo, and a tendency to rotation of the body from right to left. Sensation was perfect, and the intellect clear. Whilst in the hospital, the youth had several attacks of epileptiform convulsions; and the cephalalgia, vomiting, and facial paralysis increased. Death occurred suddenly in an attack of coma fifty-three days after he entered the hospital.

On *examination*, the cerebral cavities were found to contain a large quantity of slightly albuminous fluid. The right hemisphere of the cerebellum contained a tumour nearly as large as a hen's egg. At one point the morbid mass had destroyed the substance of the cerebellum so as to become adherent to the dura mater; it scarcely reached beyond the middle line, so that the left hemisphere was healthy. It was tuberculous, of a white yellow colour, with a greenish tint, and presented an irregular surface. The substance of the right hemisphere of the cerebellum was softened, as was also the floor of the fourth ventricle, in which the softening was limited to the right side. The left lateral ventricle was much distended, the right less so. The remaining portion of the brain was healthy. A few milary tubercles existed in the upper lobes of the lungs.

Dr. Abercrombie has supplied many other observations on tuberculosis of the cerebellum in all of which intermittent headache, convulsions, giddiness, more or less affection of sight appear as prominent symptoms, and vomiting in almost all; but

* Op. cit., tome ii., p. 611.

† "Moniteur des Sciences Médicales," Juin 25, 1861.

in one case in which an encysted tumour was situated high up in the cerebellum, and consequently away from the fourth ventricle, there was no sickness.

CASE 58.—A woman, aged about 50, had been ill for a year or more before her death, during the greater part of which time she had been confined to bed, or able to be out of it only a part of the day. She was affected with violent paroxysms of headache, which usually attacked her in the night, or about four o'clock in the morning, and generally continued for two or three hours, when it subsided, and left her tolerably easy till the same time the following night. Sometimes the attack was of shorter duration, going off in a quarter or half an hour. During the paroxysm the pain was most intense, and was sometimes accompanied or succeeded by delirium, and sometimes by coma of short duration; on several occasions squinting was observed. Her death was rather sudden: she went to bed at night in her ordinary health, and was seized with her usual paroxysm, which went off about the common time; but it returned a second and a third time, and she died early in the forenoon.

INSPECTION.—There was considerable effusion in the ventricles of the brain, without any disease of the substance. Between the lobes of the cerebellum, at the upper part, there was a firm, white cyst, containing upwards of an ounce of transparent albuminous matter of a pretty firm consistence; and in the lower part of the cyst there was a little coagulated blood.*

As in M. Andral's cases, paralysis does not generally appear. In some, the muscular affection is described merely as unsteadiness in walking; in others, as manifesting itself in a want of control over the movements of the arms or legs. Hence, when present, and associated with the characteristic symptoms above described, there is good reason to infer that the cerebellum is the seat of disease.†

M. Hérard also relates the case of a tumour in the cerebellum.‡ The patient lost all power of co-ordination, of associating

* "Pathological and Practical Researches," pp. 166—174.

† In the "Journal de Physiologie Expérimentale," tome vi., Dr. Petiet describes a case of softening of the entire cerebellum, in the progress of which the patient, in attempting locomotion, could only move backward. I also remember a case which occurred in the Hôtel-Dieu, in 1829, of a woman with amaurosis, who was irresistibly impelled to move backward when requested to walk, and in whom a diseased cerebellum was discovered after her death.

‡ "L'Union Médicale," 1860, tome iii., p. 230.

the movements necessary for locomotion, or even for standing; but there was no paralysis of sensibility or of motion of the muscles in any part of the body. There was, however, obstinate vomiting.

If a tumour exist in the interpeduncular space behind the mamillar bodies, it is apt to produce paralysis of motion on the side of the body corresponding to that on which the lesion exists. Dr. Brown-Séquard was, I believe, the first to notice this fact, and he regards the phenomenon as owing to reflex action; but if the non-decussating fibres of the corpora pyramidalia preserve the same relative position with respect to the decussating fibre as is seen in the medulla oblongata, and as I have been able to trace them some short distance into the pons Varolii, until they reach the crura cerebri, then may they be regarded as the direct channels of communication between the two crura cerebri and the corresponding sides of the spinal cord; and pressure made on them should (if any paralysis be caused) produce paralysis of the muscles on the corresponding side of the body.

I have the notes of a case in point which was communicated to the Medical Society of London by Dr. Ogle, but I am unable to refer to the source from which I obtained them. The subject was a middle-aged woman, who had been an epileptic, and had lost her sight for five years. She also suffered from partial loss of muscular power on the left side of the body, and contractile hyperæsthesia of the left side of the face and head, together with impairment of the senses of hearing, taste, and smell on the same side. The inspection of the body after death disclosed an aneurism of the left anterior cerebellar artery, so placed as to implicate the superficial part of the pons Varolii: the apparent root of the fifth nerve, and the facial nerve were also pressed upon, the latter in its course towards its exit from the cranium. Now, the anterior or superior cerebellar artery winds round the crus cerebri, and the position of the aneurism was precisely that which Dr. Brown-Séquard supposes may produce paralysis by pressure on the anterior surface of the crura cerebelli.

Out of 268 cases of hemiplegia, Burdach met with fifteen in which paralysis occurred on the side corresponding with the structural lesion within the skull, but the precise seat of disease

is not stated. If, however, on further investigation, it should appear that the non-decussating fibres of the corpora pyramidalia are always implicated in these cases of direct influence, the further inference may be drawn that they have the same paralyzing effect on one side of the body that the decussating fibres, by their cross action, have on the other. Many interesting questions would naturally follow such conclusion, and none more so than that of determining whether, in every act of muscular contraction and of perception of sensation, there may not be an inverse reaction along one set of nerve-fibres, to establish an electric equilibrium to the disturbance which has been set up by the ganglionic cells in another set; and whether a solution of continuity in either may not destroy the normal electrolytic process, or, in other words, the physiological action of the whole.

If it be so, the suggestion of M. Auguste Comte,* that the brain is no longer an organ but an apparatus, would be further illustrated, and we approach one step nearer the determination of the conformity between the physiological action and the anatomical structure of the different parts of that complex apparatus.

I have incidentally alluded to a paper communicated to the Royal Medical and Chirurgical Society, as a contribution to the Pathology of the Pons Varolii, by Dr. Hermann Weber;† and as two of the cases therein described were uncomplicated with affections of any other parts of the encephalon, they have the exceptional interest of circumscribed experiments performed by nature, and give additional pertinency to case No. 37, which I have described. A summary of each case, as given by Dr. Weber, will suffice here.

CASE 58.—A tuberculous subject, a journeyman baker, aged 25, had vertigo, then motor paralysis in the limbs of the right side, afterwards anæsthesia in the left side of the face; later, also diminished sensation in the limbs of the right, and diminished motion in those of the left side; contraction of both pupils, especially the right. Eighteen hours before death, an attack of convulsions, followed by loss

* "Cours de Philosophie Positive," tome troisième, p. 797.

† "Medico-Chirurgical Transactions for 1861," vol. xxvi., p. 151 *et seq.*

of power of articulation and deglutition, perfect motor paralysis and anæsthesia in the limbs of the right, imperfect in those of the left side, without loss of consciousness.

INSPECTION.—Tubercle in the left half of the pons Varolii, with softening in the circumference, and hæmorrhage in the latter.

CASE 59.—A boy, aged 7, affected with chronic hydrocephalus and tuberculosis; six months before death had convulsions in the left arm and leg; pain in the right side of the face; later, he had motor paralysis in the limbs of the left side, and anæsthesia in the right half of the face; his consciousness was undisturbed; the pupils were contracted, especially the left; the patient had several attacks of shaking of the whole body, each attack lasting about eight or ten minutes. Four weeks before his death the paralyzed limbs became rigidly contracted; eventually death occurred under symptoms of tubercular meningitis.

INSPECTION.—A tubercle, about half an inch in diameter, was found situated in the lower or anterior portion of the right half of the pons Varolii, near the origin and causing atrophy of the right trigeminus; the nerve substance around the tubercle was softened, and of a yellowish red colour. The fibres of the sensitive root of the right fifth nerve appeared thinner than those of the left.

In all these exhibitions of nature's spontaneous workings, the diagnostic signs harmonize so completely with the anatomical relations of the parts implicated, that in the great majority of cases the symptoms notify the particular seat of disease.

Tuberculosis of the cerebrum is more frequent than that of any other part of the encephalon, and in the great majority of instances the morbid matter is found deposited in, or near to, the grey substance, either of the convolutions, or of the corpora striata and optic thalami.

M. Gendrin observed that when tubercle exists in the grey substance of the anterior lobes, it is apt to produce acute mania, which comes on gradually, and irregularly in paroxysms, and to end in dementia. In the peduncles of the brain he observed that it is often attended with convulsions of the legs of the corresponding side and paralysis of the opposite site of the body.*

In childhood, tubercles are generally diffused over different

* "Recherches sur les Tubercules du Cerveau et de la Moëlle Epinière," par A. N. Gendrin, 1823, 28 et 30.

parts of the cerebrum; but in youth and adult age the morbid matter is more frequently deposited in one solid mass. Being developed in the interstices of the nerve-cells or nerve-fibres, it is probable that no manifest indications of functional disturbance appear until injurious pressure be made on the surrounding tissues.

And when the cerebrum has ceased to accommodate itself to the presence of the adventitious deposit, the symptoms are often exceedingly obscure. Headache, corresponding to the seat of disease, is generally the first symptom to appear, and it is often associated with vertigo. After a time, paralysis manifests itself, together with contraction or spasm of the affected muscles. The intellect is rarely implicated in the early stage of the infirmity.

The following example is from Dr. Abercrombie :*—

CASE 60.—A girl, aged 7, had been falling off for about two months before her death, having some cough, with considerable emaciation; but her appetite was good. On the 22nd of July, 1826, she had pain in the bowels, with diarrhœa and some vomiting. These symptoms were relieved by the usual remedies; but she still complained of pain in her bowels, and had some cough. Three or four days after this, she complained of headache, and her speech was sensibly impaired: about this time, also, she complained of pain in the right ear. Some peculiarity of speech had been observed before on one or two occasions, when she was able to go about. On the 27th she was affected with headache and pain of the ear, with embarrassment of speech and a small, frequent pulse. On the two following days she was much relieved in regard to pain, and the symptoms assumed more the character of continued fever. On the 30th there was considerable coma, so that she could scarcely be made to answer a question: pulse 90; the pupil much dilated; and there had been a return of severe headache. On the 31st she was speechless, with nearly perfect coma; pulse 80. She continued in the same state on the 1st of August, with the pulse becoming frequent. On the 2nd she began to be affected with paroxysms of convulsions, which attacked only the right side of the body. The limbs of the left side appeared to be paralytic, or at least were never observed to move, even during the convulsions of the right side. These paroxysms continued to recur for four or five days; she then sunk into a state of perfect coma, and died on the 10th. She

* "Pathological and Practical Researches," pp. 81, 82.

had retained the power of swallowing liquids when they were put into her mouth, and seemed to recover a slight degree of motion of the left arm.

INSPECTION.—On removing the dura mater, several patches of false membrane were found on the outer side of the right hemisphere, chiefly at the openings of the convolutions, and dipping down considerably between them. On cutting through this hemisphere, a defined portion was met with in a state of recent inflammation, presenting a uniform red colour and a natural consistence. It was about $2\frac{1}{2}$ inches in length, extending from before backwards, about an inch in breadth, and as much in thickness. At its interior part, it was connected with another portion, about an inch in extent in all its dimensions, in a state of perfect ramollissement, and of a yellowish white or ash colour; and the two structures evidently passed into each other, the inflamed portion becoming gradually softer as it approached the softened part. Along the whole of that part of the hemisphere through which the inflamed mass extended, all the convolutions were perfectly glued together through their whole extent by a deposition of very fine adventitious membrane; and there was a similar adhesion of the anterior to the middle lobe. There was slight effusion in the ventricles, but the central parts were healthy. In various parts of the brain very minute tubercles were observed; and on the base of the brain, at the junction of the left crus cerebri with the tuber annulare, there was an irregular tubercular mass of considerable extent, mixed with adventitious membrane. In the lungs there were numerous minute tubercles, all in a solid state. In the mucous membrane of the intestines, especially at the lower extremity of the ileum, there were observed numerous minute black spots, each of which, when viewed by a lens, appeared to be surrounded by a minute circle of inflammation.

Dr. Calmeil has recorded the following:*

CASE 61.—M. Alfred, aged 22, when three years old had measles, from which he was recovering, when he was suddenly seized with coma and violent convulsions of all four extremities, which continued almost uninterruptedly for twelve hours. On the following day he was observed to be deaf, blind, and unable to articulate a single word. At the end of fifteen days, however, he regained the sense of hearing; and, about a year after, he could articulate some few words, but he remained blind. Shortly after the attack, it was observed that he walked with some degree of difficulty, and that the movements of the *right*

* Op. cit., tome ii., p. 411—416.

arm were very restricted. From that period, too, he had frequent but mild attacks of epilepsy until he was nineteen years old, when the fits recurred after very long intervals. Up to the age of thirteen, his intellect remained stationary; he learnt the value of a few words, and could express his wants: but his habits were dirty, and at the age of nineteen he was perfectly idiotic, his power of speaking being gradually reduced to the imperfect utterance of a few words. In walking he would lean against a wall or upon a stick, and drag one leg after the other, the right being apparently the weakest, and the right arm was rigidly bent. The pupils of the eyes were widely dilated, but the eyes themselves insensible to light. About two months before his death, he had frequent cough with expectoration and copious perspiration, and eventually died with all the symptoms of tubercular phthisis.

On *examination*, the right side of the body and the right limbs were much smaller than the corresponding parts of the left side. Considerable serous effusion was found over the cerebral hemispheres on both sides. The left hemisphere, especially the posterior lobe, was sensibly smaller than the right; and in cutting into it, a stickiness was felt, and a dead white colour seen, which were evidently due to the deposition of some abnormal matter. The convolutions were small, thin, hard, and of a bright yellow colour. On the right side, also, the convolutions were atrophied and indurated; but the diseased condition did not extend far from the surface. The posterior lobe of the right cerebral hemisphere was undeveloped. The corpora striata and optic thalami, as well as all other parts of the encephalon, were healthy. The optic nerves were reduced to shreds and very hard.

The lungs were found full of tubercles.

In this latter case the morbid deposit appears to have acted as the diffused centres of irritation, and perhaps, as Dr. Calmeil supposes, of inflammation; and to have arrested the assimilation of the nerve-substance proper. But it is not in this instance alone that disease of the cortical portion of the cerebral hemispheres may be pointed at as influencing the development of the intellect: so far, indeed, is this from being the case, that I am not aware of a single subject of dementia referred to by Dr. Calmeil, in whom a microscopic examination of the vesicular portion of the brain has not disclosed some morbid product.

I would also refer the reader to a valuable contribution to the Pathology of Insanity by Dr. Jno. Webster,* who has given

* "Medico-Chirurgical Transactions," 1845, vol. xxviii.

the result of his dissections of thirty-six cases, in every one of which some diseased alteration of structure was manifest.

In both cases the symptoms pointed to the cerebrum as the seat of disease; and if to such tuberculosis we annex the fact of the tendency of other organs to be similarly affected, we have at once an explanation of the frequent accompaniment of pain in the belly and diarrhœa which Dr. Abercrombie often observed in tubercular disease of the brain.

The following case of encysted tumour in the centre of each cerebral hemisphere, also recorded by Dr. Calmeil,* is remarkably analogous to tubercular disease.

CASE 62.—M. Adrien, a locksmith, whose habits had been unimpeachable, and health perfect up to the age of 29, suddenly became addicted to drink; and each successive night the expression of his face and the exuberance of his conversation betrayed, as was thought, alcoholic excitement.

In six months he became brutish in morals and intellect, a confirmed drunkard, with stammering speech and stumbling gait.

Five months later, his incoherent ideas and excited manner induced his friends to place him in an asylum; where, notwithstanding the deprivation of stimulants, his power of locomotion rapidly decreased, the weight of his body inclined more and more to the left side, whilst the left arm and leg were constantly agitated by convulsive movements of the muscles. Spasmodic contractions of the right arm and leg were also observed.

When received in the Imperial Institution of Charenton, he lay as though he were stunned, unable to appreciate the sense of questions addressed to him concerning his health, with his muscular system considerably paralyzed, his features changed, and his constitution generally very much weakened.

Eight days after, an epileptic attack deprived him of all remaining muscular power, and he lay dispossessed of consciousness and motion; but when his skin was irritated, reflex movements of the legs occurred, and the patient groaned. Both arms were rigidly bent, and the pupils of the eyes were singularly contracted. The tongue was dry, deglutition became more and more difficult, until death occurred, a little more than a month after his admission.

On *examination*, the dura mater was healthy; but there was serous effusion into the arachnoid cavity. The pia mater adhered to the

* Op. cit., tome ii., p. 44—46.

convexity of the cerebral hemisphere on each side, and the cortical substance under the adhesions had undergone red softening.

In the centrum ovale of each hemisphere, in the very centre of the fibrous substance, a large cyst containing sero-purulent fluid was discovered ; around which, and extending to the corpus callosum on each side, the brain substance was softened ; but the corpora striata and optic thalami retained their healthy condition, as did all the other parts of the encephalon.

DIAGNOSIS.—The relative frequency of occurrence of the deposit of tubercular matter which has been observed in the several parts of the brain, may in some degree assist our diagnosis. The cerebrum, as I have already observed, is most frequently the seat of tubercle ; the cerebellum is less often implicated in the disease ; still less so is the pons Varolii, and least of all is the medulla oblongata. According to the observation of Rokitansky, the grey substance of the encephalon is most obnoxious to tuberculosis ; its usual situation in the cerebrum being “ either near the periphery, or more deeply amongst the grey portions of the corpora striata and optic thalami. The corpus callosum, fornix, septum lucidum, and crura scarcely ever contain any.”*

Tuberculosis of the brain is of less frequent occurrence as age advances ; consequently, the great majority of cases occur in children, and the disease generally coexists with tuberculous disease of other organs, such as the lymphatic glands or the lungs. Hence, when symptoms like those described in the foregoing cases occur in a child of a tuberculous diathesis, especially if tubercles exist in other structures of the body, it is a fair inference that the brain is similarly affected.

PROGNOSIS.—Notwithstanding that tubercles are deposited in the interstices of the cerebral substance, and that they do not implicate the surrounding tissues, except as foreign bodies to which the brain has the power of accommodating itself to a very great degree, yet tuberculosis of the brain is a most formidable disease. MM. Broussais and Bouillaud considered that in all cases it resulted from a chronic inflammation of the organ ; but it has been observed to occur so often without a single symptom

* “Pathological Anatomy,” vol. iii., p. 428.

of antecedent inflammation, that pathologists generally regard tubercles in the brain as a morbid deposit from the blood, intercalated between healthy tissues, where it may remain, as a latent disease, until, either by mechanical pressure or irritation, inflammation is set up; and then the disease proves fatal by the disturbance of the functions of the brain, before any other change than, perhaps, some surrounding softening of the cerebral substance has taken place. M. Roche considers that from twelve to fifteen days is the average duration of this latter condition.*

TREATMENT.—In accordance with the above views, the most effective treatment is that which may prevent the occurrence of the disease in those children who are constitutionally obnoxious to it: but if, unfortunately, such precautionary measures have not been adopted, and there is reason to apprehend the existence of tubercles in the brain, then the great indication of treatment is to protect the affected organ from every form of excitement which may occasion inflammatory action.

The first object is best accomplished by such prophylactic means as are found to be most useful in ordinary cases of tubercular diathesis; namely, a healthy residence near the sea, good nutritious food, suitable exercise, and warm clothing. But to ward off an impending inflammation, the greatest prudence in every hygienic resource is necessary; and when symptoms of congestion or of chronic inflammation appear, the application of leeches and cold to the head, an occasional blister to the nape of the neck or behind each ear, small and repeated doses of calomel, and, as soon as mild, unstimulating tonics are admissible, a course of quinine, with or without iron according to the circumstances of the case, are the most serviceable remedies. To subdue symptoms of irritation, sedatives may often be administered with great benefit. As in all other cases of tuberculosis, cod-liver oil is an excellent adjuvant.

Cancer of the Brain is also characterized by symptoms of irritation: but whilst tubercle is a disease of childhood, cancer is a disease of advanced age. Tubercle, as we have seen, never exists at the expense of the tissues of the organ in which it is deposited: cancer, on the contrary, always does. The infiltrated form of

* "Dictionnaire de Médecine et de Chirurgie Pratiques," art. Tubercule.

medullary carcinoma, in which cancer cells are deposited between the vesicular or fibrous portions of the brain, may appear to be an exception to the rule; but even this malignant infiltration derives its elements of increase from the surrounding tissues, exhausts their energy, changes their physical condition, and eventually destroys their function.

In consequence of this diffused influence,—partly, too, in consequence of the nerves of special sense being often implicated,—cancer of the brain is very apt to produce paralysis of those perceptions to which the organs of the special senses are subservient.

Like tubercle, cancer affects the encephalon far more frequently than the spinal cord; and its relative frequency in the several parts of the brain has been observed to be about the same as in tuberculosis. Out of forty-three cases, Andral found the cerebral hemispheres affected in thirty-one, the cerebellum in five, the pituitary body in three, and the pons Varolii in one. In three cases the spinal cord was the seat of disease.

As regards bulk, cancerous tumours of the brain have been found varying from the size of a hazel-nut to that of an entire cerebral hemisphere; and in those rare cases where two malignant masses have been discovered, the second has been so often observed to be symmetrically seated in the corresponding part of the opposite side, as to take from its location the character of chance. May not the symmetrical disposition of the nervous centres and outspread nerves, their interconnexion, and their influence over every bodily function, explain this latter phenomenon?

In ten out of the forty-three cases recorded by Andral, this malignant affection of the nervous centres was associated with a similar disease in some other part of the body;* but this secondary character is not sufficiently general to assist materially in forming a diagnosis.

In conformity with these observations, it may be remarked that the symptoms, in so far as they denote irritation, closely resemble those of tubercle. In paralysis, which may assume the character of hemiplegia, paraplegia, or general paralysis,

* “Clinique Médicale,” tome v., p. 634.

the palsied muscles are generally contracted, and sometimes agitated by convulsive movements occurring in paroxysms, during the intervals of which there may be complete paralysis. In some instances epilepsy has been known to depend on cancer in the brain. In all, the form and extent of paralysis are due to the part and proportion of the brain implicated in the disease.

Various lesions of sensibility have been observed in cancer of the brain: hyperæsthesia in some cases, anæsthesia in others, and in a few instances dysæsthesia, or a fallacious perception of the qualities of external impressions.* But in almost all cases cephalalgia, often of a sharp, shooting character, is an accompaniment.

Dr. Calmeil has been led to the conclusion that in about half the number of cases of this disease insanity is produced, and that in five-eighths of the number there is paralysis in some form or other.† Convulsions, being an expression of irritation, appear at a very early period, and often cease when muscular paralysis is complete.

This latter circumstance may cause much perplexity in our attempts to determine the nature of the disease, and the particular part of the brain that is the seat of it; for the primary irritation may become the source of reflex action, and thus give rise to the most ambiguous symptoms. Yet I think that in the great majority of cases a careful analysis of the symptoms will lead to a tolerably correct diagnosis as to the position, though not perhaps as to the precise character of the lesion.

In Dr. Yelloly's case (No. 56) we have an illustration of the influence of a malignant tumour pressing on the medulla oblongata; and an interesting addition to the pathology of the pons Varolii is supplied by Mr. Salter,‡ of which the following is an abstract:—

CASE 63.—George Langdown, aged 35, after wading up to his waist in water and neglecting to change his clothes, complained of pain in the head over his right ear and temple, then over the forehead, and eventually at the back part of the head, the nape of the neck,

* "Cours de Pathologie," Andral, vol. ii., p. 614.

† "Dictionnaire de Médecine," art. Encéphale (Cancer de l').

‡ "Edinburgh Medical and Surgical Journal," vol. ii., p. 469.

and between the shoulders. He had occasional vertigo, and often felt faint and sick, but did not vomit. The pain in the occiput became very severe, and was but little relieved by remedies. Five months after thus suffering, he was seized with hemiplegia of the left side. The eyelids remained half closed, and the retina of the right eye became nearly insensible. A sudden and strong light had but little effect on the dilated pupil of that eye. He partially recovered the power to move the paralyzed extremities, but the cephalalgia continued as severe as ever. Frequently—sometimes as often as twenty times a day—he was seized with pain and giddiness, when he would call some person to hold his head, which gave him great relief. Each fit of vertigo was followed by stupor, lasting four or five minutes, during which he was perfectly unconscious; and when the fit was about to terminate, a profuse perspiration broke out over his face. After a year or more of this suffering, he gradually became paraplegic and died.

On *examination*, considerable effusion of an opaque, milky fluid existed between the tunica arachnoides and pia mater. The vessels of the pia mater were gorged with blood; and on cutting into the substance of the cerebrum, the points of blood on the surface of the incision were large and numerous. The brain generally was soft, and both cortical and medullary matter were darker coloured than natural. A considerable portion of the pons was converted into a substance of a fleshy appearance, forming on its surface two triangles, the apices of which nearly joined in the centre. The bases occupied the anterior and posterior margins. The anterior base extended into the right crus cerebri, and implicated the apparent roots of the *motores oculorum*. The diseased mass was hard, firm, and fibrous.

The trifacial nerves were in this case unharmed and maintained their healthy function, but the malignant matter appears to have impregnated the third pair and to have destroyed their inherent property. And not only was their peculiar property destroyed, but the morbid influence was diffused to the nerve of special sense, and thus furnished an example of the tendency to which I have before alluded. In other respects we have evidence of the same irritation which is characteristic of tuberculosis, whilst the symptoms generally point to the pons Varolii as the seat of disease.

M. Andral has made an analysis of the symptoms as they occurred in thirty-six cases of tumours in the cerebellum, and in none of them was the intellect disturbed except when the

convolutions of the cerebral hemispheres were implicated in the disease;* the result of excited vascular action in the cerebrum having been observed in the seven cases referred to.

Lesions of motion were found to be far more frequent, and, from the interlacement which has been described between the fibres of the inferior layer of the crura cerebelli and those of the corpora pyramidalia, in their passage through the pons (page 13), such diffusion of morbid influence might be expected. Twenty-eight cases were attended with more or less paralysis; but varying so much in completeness and extent, that no satisfactory explanation beyond that of reflex action can be offered to account for the difference. One thing, however, was constant, and that was a crossed action whenever hemiplegia existed.

Involuntary contraction of muscles was observed more frequently than paralysis, the whole body being in some cases agitated by convulsive movements, at intervals of various duration. Sometimes one limb only was affected; in others, two; sometimes the head was forcibly inclined backward. In many cases where lesion of muscular motion obtained, a loss of the power of co-ordination was the characteristic phenomenon. An interesting case of this kind is recorded by Dr. Latham in the "Medical and Physical Journal."*

Sensation, too, was found to be as variously affected as motion in these cases of tumours in the cerebellum. But this spirit of calculus under the special garb of statistics is not calculated to advance our knowledge of the pathology of the cerebellum, for it merely determines the numerical results and exceptions of lesions indiscriminately seated in a very complex organ.

If every nervous fibre could be traced to its absolute terminus or origin in the brain, it would probably be found that every part of the body has its representative in a determined part of the brain, so that any lesion of that part *must* affect the function of the organ from which it receives or to which it sends nerves. Hence, as the disentanglement of the reflex or occasional sym-

* "Clinique Médicale," tome v., p. 722.

† July, 1826. In this case a cancerous tumour grew from both lobes of the cerebellum, and extended into the spinal canal as low as the sixth cervical vertebra; but, although the case lasted fourteen months, paralysis occurred only thirty days before death.

ptoms from the direct or essential is effected, it will perhaps appear that the central lobe of the cerebellum has some physical connexion with the genital organs; that the nerve-fibres which pass to the corpora quadrigemina are implicated in cerebellar disease when amaurosis results therefrom;* that those portions of the lateral lobes which send transverse fibres to the crura cerebelli, to interlace with the fibres of the corpora pyramidalia, are involved in disease when there is loss of co-ordination of muscular motion; and that that part of the cerebellum which overlies the fourth ventricle, and which is in the immediate vicinity of the nuclei of the eighth pair of nerves, is affected when obstinate vomiting is a prominent feature of the disease. This latter phenomenon, however, may depend on reflex action, as exemplified in Dr. Alderson's case (No. 38); or on extension of structural lesion, as in M. Vulpian's case (No. 57).

Paralysis is a far more frequent attendant on cancer of the cerebrum than on that of any other portion of the encephalon; and, notwithstanding all that has been said to the contrary, I find in almost all cases *where the substance of the cerebral hemispheres was the seat of the morbid production*, that the functional disturbances have been strictly in harmony with the views which I have advanced, and, which are, in fact, the prevailing theories of the present day.

Without troubling the reader with the details of many cases, I will place in juxtaposition the symptoms and structural lesions as I have casually extracted them from various authors, whose names are satisfactory vouchers for the accuracy of their records.

* The following is surely no irrelevant instance of a peripheral irritant reacting on the nervous centre, probably the cerebellum:—"Dr. Lee related the case of a lady, whom he saw in consultation with Mr. Bowman and Dr. Ferguson, suffering from disease of the *retina* and *albuminuria*. From having previously seen a case in St. George's Hospital, in which *albuminuria* and dropsy, occurring in a pregnant female, had disappeared on the spontaneous expulsion of a dead foetus, Dr. Lee advised the induction of premature labour. This was not at once carried out; but after some delay *some convulsion* occurred, and it was then determined not to wait any longer. At this time there was *amaurosis*, *albuminuria*, and oedema of the face. The membranes having been punctured, labour ensued, and a dead foetus of four months was expelled. After this the *albumen* gradually diminished, and the *vision* improved."—"Proceedings of Medico-Chirurgical Society," vol. iv., No. 4.

1.*

In a man aged 58.

Acute pain in the right temple ;
right upper eyelid paralyzed ;
right commissure of lips drawn
up ; legs weakened and para-
lyzed ; intellect perfect.

An encephaloid mass in a state
of ramollissement, extending from
the level of the optic thalamus to
the base of the right cerebral
hemisphere.

2.†

In a man aged 47.

Acute pain in the left side of
the head ; hemiplegia of the right
side ; intellect perfect.

A cancer the size of a hen's
egg in the centre of the left
hemisphere, implicating the cor-
pus striatum and optic thalamus.

3.‡

In a woman aged 48.

Intellect obtuse ; idiocy ; con-
tractions of right arm and leg.

Convolutions of right hemi-
sphere, presenting a bruised ap-
pearance ; lardaceous cancer near
the valve of Vieussens ; optic
thalamus and corpora striata
healthy.

4.§

In a lady aged 64.

Paralysis of the right leg ;
motion of both arms perfect ;
sudden loss of consciousness ;
partial recovery ; profound coma ;
death.

Cancer in the anterior lobe of
the left hemisphere ; flattening of
the convolutions from congestion.

5.||

In a lady aged 77.

Convulsive movements and
weakness of left arm ; four
months after the left leg became
similarly affected ; speech at first
embarrassed, next entirely lost ;
intellect perfect ; death.

Lardaceous cancerous mass, the
size of a duck's egg, occupying the
great part of the posterior lobe,
all the middle lobe, and part of the
anterior lobe of the right hemi-
sphere.

* Andral's "Clinique Médicale," tome v., p. 642—645.

† Ibid, p. 646—648.

‡ Ibid, p. 649—651.

§ "Recherches sur le Ramollissement du Cerveau," par Léon Rostan, p. 405—409.

|| Rostan, p. 409—411.

6.*

In a woman aged 62.

Headache ; delirium ; distortion of mouth ; paralysis of right side ; insanity ; dry, hot skin ; contracted pupil ; sight imperfect ; coma ; death.

Convolutions of left hemisphere softened and disorganized ; cancerous tumour in corpus striatum ; a small one in right posterior lobe.

In most of the above cases, cancer existed in some other organ ; and in all there is evidence to attach particular symptoms to affections of particular parts of the cerebrum. Lancinating cephalalgia is apt to occur in all ; disturbance of the intellect when the cineritious substance of the convolutions is implicated in the disease ; loss of the faculty of speech when the anterior lobe is involved ; paralysis of the limbs when the middle lobe, corpus striatum, or optic thalamus is the seat of cancerous infiltration ; and more or less disturbance of the sense of sight when the posterior lobe is affected.

If we extend our observations to cancer in every part of the brain, there is ample testimony to show that intermittent headache, uncontrollable vomiting, affections of the special senses, and perturbation of the genital organs are connotative of disease of the cerebellum ; that vertigo, hemiplegia, facial paralysis, contraction of the pupils, are indicative of an affection of the pons Varolii ; and that disturbance in the functions of respiration and circulation, vomiting, and loss of the faculty of speech from paralysis of the tongue, are symptomatic of disease in the medulla oblongata.†

I freely admit that many cases are recorded apparently at variance with the above propositions ; but in numerous instances of insanity, Dr. Calmeil has detected structural lesion in the convolutions of the cerebrum by the use of the microscope, where the unassisted eye failed to recognize it : so perhaps further observation, with more perfect appliances, will give other results.

It is difficult, by means of a few illustrations, to produce the

* Rostan, p. 130—133.

† Ollivier records two cases (Observations 102 and 104) beautifully illustrative of the above.

conviction derived from the perusal of a greater number of more ambiguous cases, in all of which a significant symptom will present itself to confirm the above views.

DIAGNOSIS.—Inasmuch as the same groups of symptoms are apt to manifest themselves in different forms of disease, it is a matter of importance to determine the modifications which characterize each special lesion.

Like ramollissement and tubercle of the brain, cancer is a disease of slow progress, and in each of these affections the early stage is generally associated with intense headache, varying so much in the duration and severity of its paroxysms that no special inference can be drawn from it alone. In cancer, however, which for the most part runs a slower course than ramollissement, the cephalalgia often assumes a lancinating character, shooting from the head to the face, and, as the disease advances, to the palsied limbs, which is not apt to be the case in softening of the brain.

Tubercle of the brain is a disease incidental to youth, cancer almost always occurs in advanced age; both are usually associated with similar morbid deposits in other parts of the body: hence the period of life and the peculiar diathesis of the patient will assist in discriminating between the two.

Rostan insists on the yellow or straw colour of the skin as indicative of cancer of the brain,* whilst Dr. Walshe as positively affirms that the skin very rarely assumes the yellowish tint of cancer;† but notwithstanding these conflicting observations, a careful analysis of all the symptoms will generally lead to a correct diagnosis. A patient advanced in life, of a cancerous diathesis, having lancinating cephalalgia, with shooting pains in various parts of the body, dysæsthesia, and a yellowish skin, together with a group of symptoms indicative of disease in one special part of the nervous centre (see page 147), may, with tolerable certainty, be pronounced to be the subject of cancer.

To the above diagnostic signs may be superadded the disposition which exists in cancer of the brain to extend to nerves in its immediate neighbourhood. M. Rayer has observed, for

* *Op. cit.*, p. 404.

† “*Nature and Treatment of Cancer*,” p. 495.

instance, that in many cases of cancer of the pituitary body, amaurosis has occurred from extension of the disease to the optic nerves.

Pinel casually refers to many cases in which emasculation, in consequence of cancer of the testicles, has been followed by cancer of the brain, as illustrative of a probable relationship existing between the two organs.*

The *prognosis* in cancer is obviously bad; and equally obvious is it that the treatment can be but palliative. Much, however, may be accomplished in relieving pain by the occasional application of a few leeches behind the ears, and, at the same time, by the administration of small doses of quinine, or of the compound tincture of bark. The latter will often be found to mitigate pain, and to diminish the disagreeable sensation of cold which is sometimes complained of. The patient should, of course, be carefully protected from every source of mental excitement or bodily irritation; and, if need be, sedatives should be employed to secure sleep. The warm bath may be used to relieve the distressing formication which sometimes exists. The diet should be light and nutritive; and, if necessary, the mildest aperients administered to regulate the action of the bowels.

* "Traité de Pathologie Générale, ou des Maladies du Cerveau," p. 484.

CHAPTER IV.

PARALYSIS FROM BLOOD-POISONING.

THE various forms of paralysis which we have hitherto examined are dependent either on organic defects which render the development of nerve-force impossible, or on mechanical causes which deprive the nervous centres of that supply of nutrient material which is necessary for their healthy function.

And not only is the nervous tissue dependent for its activity upon an uninterrupted supply of arterial blood, but that activity must be maintained by a constant succession of healthy oxygenated corpuscles brought into close contact with every minute molecule of nervous matter. If this condition fail, an immediate loss of function, more or less enduring according to the nature of the disturbance, is the effect. Thus an alteration in the crasis of the blood, such as is produced by typhus fever, will often result in paralysis; and it has been shown that if the $\frac{1}{100}$ of a grain of woorara be deposited and injected into a vein of a frog, the animal is quickly rendered motionless.

In 1856, it was noticed by M. Court that there were many lame persons in the villages on the right bank of the Jumna, in Pergunnah Barra. The disease was said to be of recent origin, and was attributed to various causes, but especially to the use of bread containing the *Lathyrus sativus*, combined with the influence of bad water. In 1857, Dr. Irving collected fifty men lame of both legs. They stated that they had become paralytic during the rains, in most cases suddenly, and in many during the night. Men who had gone to bed quite well had awoke in the morning feeling their legs stiff and their loins weak; and from that day they had never regained the use of their limbs.

At first the lameness was trifling, and amounting only to an unsteady gait and slight stiffness across the knees. After a time the muscles of the loins and thighs began to ache and to feel very weak, but there were no accompanying symptoms of fever. Many of the patients looked perfectly well, and their legs, although deprived of power, did not appear to be in the least degree wasted. Throughout the whole course of the infirmity, the arms never participated in it; and it was observed that men were much more liable to be affected than women.*

These were obviously cases occurring from a blood-poison, originating, perhaps, partly in a morbid nutrition, and partly in the respiration of a mephitic air. It may seem strange that an impure or septic blood circulating through the delicate and susceptible structure of the nervous system generally should not set up a general disturbance of nervous function; but we must accept facts as we find them; and it is an undoubted truth that different blood-poisons are determined to particular nerves or nervous centres, and thereby suspend or destroy their inherent properties.

Instances in which a deviation from a healthy standard of the system has altered the constitution of the blood and suspended the function of a single nerve have a bearing on these mysterious phenomena, but fail as a clue to their explanation. There is one very suggestive case recorded by Dr. Abercrombie, of a gentleman who became deaf from excessive abstinence and loss of blood; but when he stooped so low as to produce flushing of the face, his hearing became distinct.

Again, in fever, it is a well-known fact that the proportion of fibrin of the blood is diminished in relation to the globules; but when to this is superadded the ammoniacal product which appears in the blood when pus is admitted into it,† intestinal paralysis is exceedingly apt to occur.

Plumbism begins by affecting the extensor communis digitorum, the extensor indicis, the extensor minimi digiti, and the extensores pollicis. The disease sometimes begins by affecting some

* "Notice of a Form of Paralysis of the Lower Extremities." By James Irving, M.D.--"Indian Annals," 1860.

† "Essai d'Hématologie Pathologique," par G. Andral, p. 120.

one of these, or a few fibres of one ; but they are always the first attacked. Then, as the disease advances, the radial muscles are more obnoxious to the paralyzing influence than the ulnar ; and the long abductor of the thumb is the last to yield. As the muscles of the upper arm become involved, the triceps extensor cubiti and the deltoid are the first to go, when the pectoralis major and the upper half of the trapezius are apt to follow.

Thus the thumb and index finger become weak and flexed, the wrist drops, whilst pain is felt in the back part of the forearm, gradually extending to the back part of the upper arm and shoulder. The forearm by degrees loses its power of supination, and becomes bent upon the upper arm. In this way the upper extremities are deprived of movement, and become emaciated, whilst the lower are very rarely involved.*

An interesting case of plumbism is recorded by Dr. E. Murphy, of New Harmony, Indiana, which affords a complete history of the effects of lead on the human system, and shows that it is a cumulative poison.†

CASE 64.—M. R., aged 42, was in the habit of chewing lead bullets and the lead lining of tea-boxes. In September, 1843, he had fever, and in July, 1844, he was seized with colic and constipation of the bowels, during which he was variously treated for peritonitis, abdominal neuralgia, &c. : but in February, 1846, his skin assumed a dirty yellow colour, and he had slight paralysis of the extensor muscles of the fingers of the right hand. His vision also became imperfect, and he had occasional attacks of an epileptic character. By the end of March, amaurosis was complete, the paralysis of the hand had considerably increased, and the left hand was very weak. In June, 1847, both hands were paralyzed, dropping from the wrists, and neither could be straightened ; the upper extremities dwindled ; he had hyperæsthesia over the surface of the abdomen and the balls of both thumbs ; he had also flying pains in the lower extremities, and through the testicles.

* Romberg states that when the lower extremities are involved, it is almost exclusively in connexion with paralysis of the upper, and that the proportion is almost 1 to 6.—See his “Manual of the Nervous Diseases of Man,” translated for the Sydenham Society by Dr. Sieveking, vol. ii., p. 365.

† “Southern Medical Reports,” by Dr. Fenner, of New Orleans, vol. ii., 1850.

For these symptoms a course of mercury was prescribed—five grains of blue pill four times a day, and mercurial inunction. In three weeks a great improvement was effected.

On the 17th of July, Dr. Murphy discovered the patient's habit of chewing lead, when he looked for Dr. Burton's test and observed a blue line along the gums over four or five teeth. He then combined the aromatic sulphuric acid with the mercurial treatment, and by the 1st of August all pain had ceased. Splints were applied to the hands and wrists, which gradually acquired their natural state, and in 1850 the patient was again a strong and active business man; but the extensor muscles of the hands were not so strong as before the disease.

For nearly two years the characteristic colic of lead-poisoning preceded the paralysis; and such is the invariable course of the disease. The only change in the constitution of the blood, as observed by Andral, in plumbism, is a sensible diminution of the globules in proportion to the fibrin; and in this respect the alteration bears some resemblance to that which takes place in inflammation, which consists in a gradual decrease in the globules and an increase of the fibrin: in plumbism, however, the fibrin does not appear to be affected. But lead has been detected in the various tissues of the body, and its first effect appears to be produced on the nerves of the intestines, producing pain and constipation through the influence of the cerebro-spinal system, whilst the sympathetic system is also involved; and the result is defective secretion. Probably, it acts immediately on the delicate walls of the capillary vessels as it does on dead membranes, and so obstructs the mutual interchanges between the blood and the tissues, which is necessary for healthy nutrition, and which the thinness of the capillary walls is undoubtedly intended to facilitate.

DIAGNOSIS.—Although every symptom and the order of its appearance may be pathognomonic of lead-poisoning, yet is the disease sometimes mistaken for inflammation of the bowels or of the peritoneum, notwithstanding that the pulse is rarely if ever excited; nor is the pain of the abdomen increased by pressure. The peculiar wasting of the palsied *extensor* muscles and of the cellular tissue which surrounds them is a very distinctive sign, and it has been well described by Dr. Romberg. "This form

of paralysis," says he, "is characterized by atrophy of the muscles, and the surrounding cellular tissue and fat, supervening earlier, more rapidly and extensively, than is the case in other forms of spinal paralysis: this symptom cannot, therefore, be regarded as a mere result of inactivity. The outline of the muscles disappears; the posterior and external surface of the fore-arm, the anterior surface of the thigh where the extensors are placed, waste away and form a striking contrast with the prominent condition of the flexors. In higher degree of the malady, depressions and fossæ form, which are surrounded by adjoining healthy muscles. At last the muscular tissue disappears entirely, and allows eminences of the bone to project sharply. This may be seen in the deltoid, and in the ball of the thumb, which comes to be level with the hollow of the hand."* But of all pathognomonic signs, the blue mark to which I have already referred, along the gums, is the most unequivocal.

PROGNOSIS.—The cumulative nature of the poison renders it obvious that the earlier the symptoms of disease are counteracted by suitable remedies, the more favourable the prognosis. The younger the patient and the fewer organs implicated, the more rapid will be the restoration to health and strength. When, however, the muscles of the hand are once paralyzed, the disease is invariably one of long duration; and under the most favourable circumstances, many an oscillation between improvement and exacerbation of the symptoms will be observed.

"Evils, that take leave,
On their departure most of all show evil."

TREATMENT.—The first provision necessary for the re-establishment of health is the removal of the patient from the influence which has produced the disease, to a genial air, wherein, by gentle exercise, the sallow skin most easily regains its healthy complexion. Sulphur baths are very efficacious in this operation; and an occasional purge by means of croton oil will help to disembarass the walls of the capillaries from the accumulation of matter which obstructs the interchange of the contents of those vessels with the surrounding tissues. Sulphur and alum have

* Op. cit., vol. ii., p. 366.

been approved as specific remedies ; but M. Brachet has lately employed the iodide of potassium, giving from 3 jss. to 3 ij. in a ptisan during the twenty-four hours with complete success. He cites 150 cases in which it has acted quickly, safely, and kindly. Strychnine endermically applied over a blistered surface in the immediate neighbourhood of the paralyzed muscles has been strongly recommended by M. Tanquerel, and it may also be administered internally in $\frac{1}{20}$ gr. doses twice a day. Electricity in the form of interrupted current naturally suggests itself, and seldom fails to restore strength to the palsied muscles in these cases.

The influence which *diphtheria* exerts upon the human system is essentially of a depressing character, and its effects bear a strong resemblance to those of some diseases which are universally admitted to be produced by the introduction into the body of a specific morbid poison.

It has been observed by Empis,* that in the progress, duration, products, and general symptoms, as well as by the constitutional morbid condition of the patients in whom diphtherite occurs, a peculiar diathesis manifests itself, generating and interweaving together two inflammations, each having a special pathological character. Whether this double character of the disease be granted or not, the same condition of blood which develops the pseudo-membranous exudations on the mucous surfaces of the pharynx and air-passages produces also a peculiar depressing influence on the nervous centres, from which it has occasionally occurred that death has suddenly supervened in the course of an apparent convalescence, the fatal termination having been preceded by a sense of excessive prostration and sinking.

From the same cause, and sometimes at a later period of recovery, various forms of paralysis have appeared, suspending for a time the function either of a single nerve, or of a system of nerves proceeding from a common centre.

Dr. Peter Eade has recorded four cases, occurring from two to four months after diphtheria, in which the spinal system only was affected, producing more or less anæsthesia and loss of power

* "Researches on Diphtherite, founded upon an Epidemic of this Disease at the Hospital Necker in 1848." By G. S. Empis. Translated for the New Sydenham Society by R. H. Semple, M.D.

in the arms and legs.* The youngest patient was 17, the oldest 63; but in all the paralysis yielded to nervine tonics and a liberal diet.

During the year 1860, 210 cases of diphtheria occurred at the Hôpital des Enfants, and paralytic symptoms supervened in 31. M. Roger believes that the proportion of these cases is really a third or fourth; but several of the children were removed from the hospital before the period at which consecutive paralysis is usually developed, and others died before that period.

That the diphtheritic poison has a special affinity for the nervous tissues, is satisfactorily proved by M. Roger in the observation that such secondary paralyzes are as rare in other acute diseases of children as they are common in diphtheria.† Thus, in 1860, among 61 cases of angina simplex, 12 of typhoid fever, 33 of rubeola, 12 of scarlatina, 4 of variola, and 24 of pneumonia, not one instance of secondary paralysis occurred. Nor does it result from simple anæmia, the one case of deafness which I have quoted being an extraordinary exception. The patient may be apparently cured; every vestige of the false membrane may have disappeared; and yet, without any apparent cause, the skin is seen to lose its colour, sharp pains attack the joints, the limbs suddenly become weak, and, in a short time, unable to support the weight of the body.

Diphtheritic paralysis generally attacks both sides of the body at once, and supervenes at various periods, ranging from a few days to as many weeks or months after the pseudo-membranous exudation has been removed from the membrane on which it was localized. M. Roger's experience at the Hôpital des Enfants led him to the conclusion that the usual period of the appearance of paralysis is from the fourth to the eighth day. Dr. Eade, however, quotes a case which occurred in the Norwich Hospital as late as the fourth month. In almost all cases the loss of muscular power is first felt in the *velum palati* and pharynx, and is made manifest by a peculiar nasal twang in the voice and by difficult deglutition. Sometimes the dysphagia

* See "Lancet," July 16th, 1859.

† "Medical Times and Gazette," Jan. 4th, 1862.

exists from the very beginning of diphtheria. The soft palate hangs down on the tongue, but it may be momentarily brought into a state of contraction by means of electricity.

From the palate and pharynx the paralysis may extend to different parts of the body, or it may cease in one part and manifest itself in another. The muscles of the limbs, and indeed all the voluntary muscles, are very apt to be thus secondarily affected.

Mr. Wade, of Birmingham, has directed the attention of the profession to the proclivity to albuminuria after diphtheria, and has endeavoured to establish a relationship between them and the consecutive paralysis;* and true it is that cases of paralysis often follow albuminuria after the disease in question. This tendency is well illustrated in the annexed instance, recorded by Dr. Humphry, of Cambridge.†

CASE 65.—An undergraduate, tall, thin, and not strong, coming from Norwich in the autumn of 1860, caught cold and had rather severe diphtheria. The tincture of the sesquichloride of iron, wine, and beef-tea, gargling and sponging the fauces with solution of chlorinated soda, constituted the treatment. The throat gradually cleared; but he remained weak, and returned home. Then the urine became loaded with albumen, almost solidifying under heat, and was of low specific gravity. Partial paralysis of all the voluntary muscles supervened; he could scarcely stand, could not button or unbutton his clothes; deglutition was slow and difficult, and articulation hesitating and imperfect. Most serious apprehensions were entertained by his friends and medical attendant. I advised his immediate removal to the seaside in the South of England, so that he might be taken out into the air several times a day. He went to Hastings, and lived almost in the open air. Improvement began at once: the albumen decreased in the urine, and finally disappeared; he slowly regained voluntary power and general strength; returned to Cambridge in the spring, and has been well ever since.

But paralysis often appears without albuminuria; and this latter as frequently supervenes without the attendant paralysis. Dr. Sanderson has given the results of eight cases in which

* "Observations on Diphtheritis," 1858.

† "British Medical Journal," July 4th, 1863.

albuminuria appeared after diphtheria, and in one instance only does he speak of "extreme muscular weakness." In three of the patients no sequelæ ensued.* M. Roger also has determined that albuminuria is not an essential concomitant of paralysis.

The optic nerves are also very obnoxious to the action of the diphtheritic poison; and with amaurosis other phenomena sometimes appear which are traceable to sympathetic affections of other nerves, associated in their function with the optic nerve. Immobility of the pupil, for instance, often appears; and it is indicative of a suspension of reflex action. Mr. Lawson has published four cases in which the ciliary muscles alone became paralyzed after diphtheria, causing a temporary loss of the accommodating power of the eye.† The third and sixth pairs of nerves are generally implicated in the functional disturbance of the optic nerve; hence the strabismus which is occasionally observed.

Often, as Dr. Faure has stated, "the cutaneous sensibility is greatly diminished; in the limbs it is sometimes annulled; sometimes abnormal sensations are experienced, particularly that of formication. There is no general reaction; fever is rare, the skin usually more or less moist."‡

The intelligence, too, though more rarely than motion and sensation, is sometimes disturbed. In these cases the exhaustion reaches its extreme degree, and death is not unfrequently the result.

The occurrence of any of the above forms of paralysis would appear to be a proof of a greater amount of blood-poisoning than obtains in those cases wherein the nerve-force is preserved in its normal condition; and yet it is after the mild cases of diphtheria that paralysis most frequently occurs. This may, perhaps, be explained by the great mortality of the disease when it presents itself in its gravest form, and at a period antecedent to that at which paralysis sets in.

* "Contributions to the Pathology of Diphtheritis, Sore Throat, and other kindred Affections." By J. Burdon Sanderson, M.D.—"British and Foreign Medical Review," Jan. 1860, pp. 193, 194.

† "Lancet," May 11th, 1861.

‡ "Des Accidents Consécutifs de la Diphthérie." Par M. Faure.—"L'Union Médicale," 1857, p. 66.

PROGNOSIS.—Although the prognosis of paralysis is generally unfavourable, yet is it not so in the majority of cases under consideration. The amount of danger, however, depends very much upon the locality of the palsy; for the same amount of loss of muscular power which would cause little or no anxiety when confined to the limbs, would be regarded with great apprehension in the muscles of respiration; and this, in fact, is the principal cause of the mortality, which ranges at from twelve to fifteen per cent. Romberg's remarks on the prognosis of acineses generally are well worthy of consideration here. "In paralysis of the vagus," says he, "the access of the air is impeded, and there are changes in the aëration of the blood; the urine is retained in paralysis of the vesical nerves; hollow muscular organs, such as the pharynx, the stomach, the intestines, become distended if the nerves are paralyzed, and the contents which they ought to discharge are retained. The danger is increased by complication, especially with anæsthesia, which ushers in destructive processes, such as decubitus, &c."*

TREATMENT.—Although the great variety of opinion relative to the treatment of diphtheria is revealed by the multitude of remedies which have been successively eulogized, the measures to be adopted for the cure of the consecutive paralysis have received universal assent.

The indications are the very reverse of those which obtain in paralysis induced by inflammatory action, and the appliances which most effectually fulfil these indications are precisely those which are productive of the best results. Instead of the abstinence from all stimulating influences which in the first case must be most rigidly observed, we have here to do with a disease wherein those stimulating tonics which, by operating through the medium of the blood, excite the capillary vessels to increased action, and so give a healthy impulse to the languishing nerve-force, are the most effective.

Cusparia bark is one of these; and in consequence of the brucia which it contains, it is more effective than the bark of any of the cinchonas. But best of all are the various preparations of iron, which communicate tone to the digestive

* Op. cit., vol. ii., p. 260.

organs and diffuse a restorative energy in the nutritive faculty to every part of the body.

Strychnine, as a powerful excitant of the nervous centres, is peculiarly applicable, and may be given with advantage in $\frac{1}{2}$ gr. doses twice a day; whilst galvanism by its stimulating action on the sentient extremities of the cutaneous nerves, and its reflex action on the motor nerves, restores the power of voluntary contraction to the palsied muscles.

Other topical stimuli, such as friction, rubefacient liniments, and warm salt baths, are calculated to produce a like effect.

When practicable, a change of air is often attended with the best result.

Syphilitic paralysis has been observed so often unconnected with any apparent structural lesion of the nervous centres or of the conducting nerves, that we have reason to regard it as the result of a blood-disease.

MM. Ricord and Sandras have described cases of syphilitic amaurosis in which no change in the anatomical structure of the optic nerve could be detected; and the latter physician had under his care an athletic man in whom a progressive paralysis of a syphilitic character had made considerable progress, but who was completely cured and regained muscular power so rapidly after a course of the iodide of potassium, that the existence of structural change was out of the question.* And the subjoined instances are illustrative of the same.

CASE 66.—A woman, aged 36, was attacked with a slight inflammation of the eyes, after which she became blind, and continued so for ten months, but without any appreciable lesion of the eyes: the pupils, however, were immovable. She had severe pains in the forehead, her spirits were much depressed, and her complexion assumed an earthy aspect. There were no concomitant symptoms of venereal disease, and the patient denied the previous existence of any. Revulsives, purgatives, and baths were employed during one entire month without any result; when the patient, alarmed by the inefficacious treatment, confessed to having contracted a syphilitic disease some eleven months before, by nursing a child. Anti-syphilitic treatment, and perfect cure. †

* "L'Union Médicale," 15 Mai, 1852.

† Dupuytren, "Revue Médicale," 1832, tome xi., p. 383.

CASE 67.—Marie P., a domestic servant, aged 28, entered La Charité, under M. Rayer, in September, 1858, having been seized twelve days before with vomiting and acute pain extending from the nape of the neck to the right eyebrow. The pain was intensified by any movement of the neck or by speaking: there was, moreover, a nightly exacerbation, and a partial remission towards morning, but the pain never ceased entirely. The patient also complained of pain in the right shoulder. A mucous tubercle (*tubercule muqueux*), which appeared to be a transformed chancre, occupied a portion of the labiæ minores. This, according to the patient's account, she had first perceived only eight days previously. The glands in the groins were tumefied; there was an eruption on the abdomen and chest, numerous scales on the head, slight enlargement of the cervical glands just below the mastoid processes; no alopecia, no sore-throat; sight and the other special senses unaffected, except that of the left ear, which was considerably disturbed; a noise as of carriages and painful shootings being constantly complained of in that organ. During the exacerbations at night, cophosis of the left ear was complete, and the pains more acute.

Sedillot's pills were prescribed; and at the end of eight days the function of the left ear was perfectly restored, and the nocturnal pains had disappeared. By the 11th of October (seventeen days after admission) the sense of hearing was as acute as ever, the eruption had disappeared, the scabs had fallen off, and the patient was discharged cured.*

CASE 68.—A baker, aged 30, having had chancres on the prepuce, and no specific treatment, was seized with neuralgic pains in the left intercostal spaces, then in the right, and about twelve days after severe pain occurred in the right acromion: three days after this, intense headache supervened, each night becoming intolerable. Facial hemiplegia of the right side accompanied the headache, together with dyspepsia, sleeplessness, profound melancholy, and suicidal ideas. At the end of about four months from the beginning of his disease, the patient was put under a course of corrosive sublimate; and in four days the pains were sensibly diminished, sleep returned, and at the end of a few weeks the man was well.†

CASE 69.—Madame L., aged 31, having been thrice treated for constitutional syphilis (twice by mercury and once (1849) by the ioduret of potassium), experienced in the autumn of 1853, and

* "Des Affections Nerveuses Syphilitiques," par le Docteur Léon Gros et E. Lancereaux, p. 119.

† Yvaren, "Des Métamorphoses de la Syphilis," Obs. 23.

without any known cause, weakness in the right arm ; a few days after, the right leg became similarly affected, and at the expiration of a month the entire right side was completely paralyzed. Towards the end of the year the left arm became weak, and shortly after the left leg. Some spontaneous improvement next followed, so that the patient could walk a little, and continued so to do for about three months, at the expiration of which the four extremities became more than ever palsied, severe pains occurred in the disabled limbs, with nocturnal exacerbations and spasmodic contractions. On the 6th of December, after having had a cough for a few days, the patient was seized with dyspnoea, mucous rhonchus over the whole extent of both lungs ; and on the 10th, every symptom having gradually increased, she died. On a careful examination of the body, no structural change could be detected either in the brain or the spinal cord.*

Notwithstanding these cases which are suggestive of a syphilitic virus circulating in the blood as a cause of the paralysis, others do occur in which there is more positive evidence to show that the pains and paralyses are chiefly dependent on a narrowing of the foramina through which the nerves pass from the cerebro-spinal axis ; or a thickening of the nerves themselves ; and, probably, of the walls of the capillary vessels which convey blood to them, in consequence of a fibrinous exudation from the blood. This latter cause has been accepted by the most distinguished physicians and surgeons of Europe, and serves to explain the slow progress of cure in many instances of perfect success. An example of syphilitic disease of the petrous bone, and consequent pressure on the facial nerve in its passage through the aqueduct of Fallopius, fell under my observation some fifteen years ago.

CASE 70.—A gentleman, aged 60, contracted syphilis, for which he was put under a course of mercury ; but on the second day violent ptyalism supervened, when the mercury was discontinued, and the iodide of potassium in decoction of sarsaparilla was substituted, under the influence of which the chancres gradually healed, and his general health so far improved that he considered himself perfectly well. About six months after, he was in court pleading, and spoke for two hours without feeling any fatigue ; but in the evening he was seized

* Lancereaux, *op. cit.*, p. 106.

with otitis, sickness, and vomiting. He suffered intensely for more than a week, when the left side of the face was observed to be paralyzed, the left ear being inflamed. The left eyelid was immovable, verifying Dr. Cazali's diagnosis of affected nerve only; and a large ulcer existed on the velum palati, extending down both tonsils. On this occasion the liq. hyd. bichlor. was given without producing ptyalism. The ulcer healed; but the paralysis of the face continued until the patient died, about two years afterwards.

Dr. H. Jackson has recorded a case the history of which is suggestive of fibrinous exudation in the tissue of the nerve itself, and the gradual absorption of the adventitious substance.*

CASE 71.—George G., aged 22, was admitted into the Hospital for the Epileptic and Paralyzed on the 25th August, 1862. In the preceding February, he had a hard chancre, and was on the sick-list on board a man-of-war for three months; and in June he was sent ashore, in consequence of syphilitic rheumatism and of sores on his legs.

When admitted, there were patches of well-marked syphilitic eruption on the legs, arms, and trunk. His health had been good till the chancre appeared; and it was good in June, except for a paralysis of the hands, in neither of which had he the power of closing the fingers, but he could extend them easily. There was no loss of power in moving the arms; for, although he could not bend the fingers, he could bring down his hands on the table with great force. The fingers were red and glazy-looking.

A combination of iodide of potassium and protiodide of mercury (10 grs. of the former and $\frac{1}{8}$ gr. of the latter) was given three times a day, until the 15th of September, when the gums were slightly affected. The mercury was then omitted, and the dose of the iodide of potassium was increased to 15 grs. On the 13th of October no perceptible improvement had taken place, although the patient said he felt better. He was then ordered to take 5 grs. of Plummer's pill night and morning, the iodide of potassium as before, and 10 grs. of bromide of potassium three times a day.

From that period he improved daily, so that on the 15th of December he could grasp a little; on the 15th of January, with some firmness; and subsequently he could use his hands freely, except for purposes requiring delicate manipulation.

Two cases of double paralysis of the seventh pair of nerves are described by Dr. Roberts, of Manchester,† in both of which it

* "Lancet," July 25, 1863.

† "British Medical Review," Oct. 4, 1862.

appears exceedingly probable that syphilis caused a fibro-plastic deposit in the parietes of the meatus auditorius internus of each side, so as to produce complete deafness and double facial paralysis.

CASE 72.—An exceedingly interesting example of complete paralysis of the third nerve or motor oculi is recorded by Mr. Jonathan Hutchinson,* and it is the more worthy of being studied in consequence of the careful process of exclusive reasoning by which the diagnosis is worked out. The ptosis was so complete, that the upper lid of the left eye drooped, so much as to meet the lower one. But when the drooped lid was raised, the patient's eye was directed outward; the pupil was much dilated, being at least four times the size of the other; and when the man was asked to look to the right, the right eye passed easily outward, whilst the left could not be moved beyond the straightforward position. In looking upwards or downwards, the right eye obeyed volition, but the left remained quite fixed; the inner rectus, the superior and inferior recti, the levator of the upper lid, and the constrictor of the pupil of the left eye—all muscles supplied by one and the same nerve—being paralyzed.

The patient was a butcher, aged 29, with a pale yellow complexion. He admitted that he had drunk freely, but denied having had syphilis. He had, however, gonorrhœa some five years before; but no bubo, rash, or sore-throat followed it. He had never had rheumatism, nor had he suffered from headache. After a cold in the head, attended with hoarseness and cough, from which he had recovered for a fortnight before, he noticed his left eyelid to begin to droop. He considered himself in good health when this came on: he had neither pain nor ache in any part; his appetite was good; he slept well, and had no cerebral symptoms whatever, except the affection of the third nerve. The drooping of the eyelid increased gradually, and, before the pupil was covered by the lid, he saw objects double.

Arguing on the absence of any constitutional or cerebral symptoms, on the complete paralysis of all the muscles supplied by the third pair of nerves and no others, Mr. Hutchinson inferred that the disease could only be of a mechanical nature; and that the mechanical obstruction to function could not exist in the orbit, or the different branches of the nerve would be unequally crossed upon, and, therefore, unequally disturbed; nor in the cavernous sinus, or the fourth and fifth nerves would

* "British Medical Journal," Jan. 26, 1861.

be involved; nor in the *crus cerebri*, or cerebral symptoms would exist. Hence he concluded that it must be between the *crus cerebri* and cavernous sinus, and that it must depend on an effusion of lymph within the sheath of the nerve between those points; and on such reasoning he gave, with beneficial effect, the iodide of potassium as the most efficient remedy in producing absorption of such lymph, whether syphilitic or otherwise.

We are indebted to Dr. Barker for the history of another and equally interesting case of syphilitic paralysis, of which the following is a summary.

CASE 73. — W. A., a shopboy, aged 18, was admitted into St. Thomas's Hospital, October 3rd, 1860. A month before he perceived a numbness in the tips of his fingers and toes, which gradually extended up the arms and legs, and amounted to absolute anæsthesia. For about a week before the numbness he had severe headache, which kept him awake all night. His sight, which had always been dim, had become much worse during the previous two or three years; and he had also been deaf some years. When admitted into the hospital, he could not move his fingers or arms, and could only slightly move his legs. He could neither stand nor sit up unsupported in bed. He had no paralysis of the face, but there was impaired power in everting the eyes, which was manifestly due to the sixth pair of nerves being implicated in the disease. No tender point existed in the spine, neither did he complain of pain in any part of the body; his head was cool, his tongue coated and red over the edges, his pulse 72. He had lost all power over the bowels and bladder, so that he passed everything unconsciously in bed.

His mother denied having had syphilis, and expressed her belief that her husband had never had it.

Notwithstanding her averment, a drachm of the liq. hyd. bichlor. was given three times a day, and the spine was painted with a blistering fluid.

By the 10th of February, 1861, the patient had so far recovered that he could move his fingers, arms, and legs, and could sit up in bed: he was sensible, too, of the condition of the rectum and bladder, so as to call for assistance; and, eventually, he was discharged much improved.*

* "Medical Times and Gazette," July 27, 1861.

From these, and other cases which are constantly occurring, we know that the nervous system may be thus implicated at any stage of secondary syphilis, and that sometimes paralysis may supervene without any appreciable lesion of the nervous tissue; whilst in other instances the alteration in the crasis of the blood may result in inflammatory softening of the nervous centres, or in an exudative process, whereby a fibro-plastic material is deposited round about or incorporated with the nervous tissue, so as to compress it and disturb or suspend its special function.*

When the palsy is due to the syphilitic virus circulating in the blood, it generally appears at an early stage of the disease; but when it is dependent on an exudation of plastic lymph, it may be a year or two years, or five, or ten, or even twenty, before it supervenes; and a low state of venereal cachexia, a condition highly favourable to the exudative process, is the usual antecedent. The resulting paralysis is, for the most part, slow and progressive in its course, unless it is ushered in with symptoms of active inflammation, in which case it usually appears at a comparatively early period and runs a quicker course.

In both cases the most vascular parts of the nervous centres are the most obnoxious to the fibrinous deposits, and paraplegia is the form in which the functional disturbance most frequently shows itself. It may, however, be confined to a single nerve, as in case 70, or, as in case 73, manifest itself in the muscular system generally.

DIAGNOSIS.—The great variety of forms in which syphilitic paralysis occurs, and the frequency with which it is accompanied with symptoms indicative of structural lesion of the nervous centres, render a correct diagnosis a subject of great importance. The antecedent existence of syphilis and the subsequent appearance of secondary or constitutional symptoms; the disposition of syphilitic paralysis to appear in several parts of the body simultaneously; the absence of any other appreciable cause; and, finally, the beneficial result of antisymphilitic remedies, when others have failed,—characterize

* A case of this latter kind is reported by Dr. Gull in the 39th vol. of the "Medico-Chirurgical Transactions," 1856, p. 196.

the disease in question. But the above considerations present nothing very peculiar to distinguish the syphilitic from some other forms of paralysis, and we can depend only on the most careful investigation in respect of the cause. Rheumatic paralysis, for instance, presents many features so similar to those which appear as the result of syphilis, that it is in many cases most difficult to determine whether the rheumatic dyscrasis is not, in point of fact, engendered by syphilis.

The *prognosis* is mainly dependent on the nature and extent of the paralyzing influence. If there be good reason to think that no structural change has taken place, and that the suspension of nervous function depends solely on a perverted state of the blood, even if the paralysis be extensive and important organs are implicated, there is more substantial ground for a favourable prognosis than when the exudative process has once set in. And, in this latter state of things, there is a greater chance of arresting the mischief, if it be dependent on syphilitic cachexia, than if inflammation be the cause of the extravasation of lymph, which generally terminates in ramollissement. When the osseous system is implicated in the structural lesion, an additional element of danger exists in the inflammatory attacks which invariably supervene during the course of such complication.

TREATMENT.—The antecedent course of the disease and the intrinsic nature of the paralysis being determined, the indications of treatment will next demand our consideration. If the primary disease be of recent date, and a morbid crisis of the blood the source of palsy, the specific treatment by mercury or iodide of potassium, or by the two combined, will, in the great majority of cases, lead to a successful issue. If symptoms of inflammation present themselves, all the excretions should be encouraged by suitable evacuants: but great caution is necessary in the abstraction of blood; for as syphilitic cachexia is dependent on a diminution of the blood-corpuscles, the exudative process may be set up by one influence which is superinduced to remedy another. So far the condition of the blood is an important consideration in the treatment of the disease in question; for if there be a comparative diminution of the globules and a corresponding low state of health, the iodide of

iron will be found to be a valuable adjunct to the iodide of potassium; or it may be that a preliminary course of chalybeate tonic will be indicated as a means of enabling the patient to bear the necessary doses of the iodide of potassium. In France much reliance is placed in warm sulphur baths, in conjunction with the specific treatment above referred to; and accordingly Aix-la-Chapelle, Aix in Savoy, Bagnols, and Barèges are in great repute. The waters of Harrogate, however, are equally efficacious. According to the experience of M. Duchenne, we are encouraged to count upon considerable assistance, in the restoration of nervous function and of muscular power, by the use of electricity.

There are many other sources of blood-disease in each of which a particular manner of localizing itself exists. Thus, for example, the mercurial dyscrasis is apt to produce a tremulous palsy in the hands and arms; the effect of arsenic is to cause the same form of tremulous palsy in the feet and legs, as well as in the hands and arms; whilst the drunkard's palsy is attended with tremors of the muscles generally. Many animal and vegetable poisons also produce their peculiar dyscrasies, but without any very special form of resulting paralysis. Cholera, typhus, atropa, tobacco, stramonium, hyoscyamus, &c. are some of these; but in all, the general rules of treatment as prescribed by Sir Benjamin Brodie should be observed. First, apply antidotes; and, secondly, keep the patient alive until the poison is eliminated from the system. For this latter purpose, all the excretions should be encouraged: sweating by heat; the evacuation of the bowels by purgatives; and the free action of the kidneys by suitable diuretics.

But cases will present themselves in which the emotions of the mind, like an electric shock, act with such force on the bodily organs as to prostrate and destroy the stoutest frames. In these, a decomposition of the blood has been detected and described by Rokitansky, as "attenuate; in colour comparable to raspberry jelly, or of a dingy red; facile of imbibition, expanded in volume, often engaged in gas-development, frothy."* On such *septic crasis*, as Rokitansky has called it,

* Rokitansky's "Pathological Anatomy," vol. i., p. 406.

may we explain many a story of the operation of mental and moral causes in unhinging the machinery of human life. How, for instance, but by some such cause can we account for a fact related by Dr. Carpenter, of a child, who was taken from its cradle—where it lay playing, and in the most perfect health, never having had a moment's illness—by its mother whilst in a state of strong excitement from fear and terror, into which she had been thrown a short time before? She gave it the breast; but in a few minutes the infant left off sucking, became restless, fainted, and sank dead upon its mother's bosom.

This, it is true, is a very extraordinary example of the mysterious connexion between mind and body; but there are few medical practitioners who cannot reveal strange instances, which have fallen under their own observation, of the action between the immaterial agent and the physical object; and it is by the contemplation and due appreciation of such reciprocal operation that the physician acquires an incalculable auxiliary to his ordinary remedial agents in alleviating pain, calming mental distress, and soothing the torture of those organic changes which constitute pathology. In thus exercising the legitimate duties of his noble profession, he may

“minister to a mind diseased;
Pluck from the memory a rooted sorrow;
Raze out the written troubles of the brain;
And, with some sweet oblivious antidote,
Cleanse the stuff'd bosom of that perilous stuff,
Which weighs upon the heart.”

CHAPTER VI.

PARALYSIS FROM REFLEX ACTION.

WHEN a morbid impression is made on an incident nerve, an immediate change occurs in the grey matter of the ganglion in which that nerve terminates; and the impression is transmitted to the roots of the motor nerves, to be reflected back on the nerves themselves, with an intensity which may vary according to the amount of the primary impression.

An antecedent peripheral irritation, starting from some sensory nerve, is the condition on which reflex paralysis depends; and the modifications of such outside cause induce corresponding changes in the effect. On the discontinuance of the causation the paralysis will often disappear, although every remedy may be unavailing as long as the primary irritation exists; and if, as is sometimes the case, the *contre-coup* be so severe as to cause death, no structural lesion is detected in the nervous centres.

A prolific source of reflex action exists also in the branches of the sympathetic nerves, the affections of which are transmitted to the spinal cord, and reflected back on the vaso-motor nerves; and hence it is that, of all causes of reflex paralysis, the most frequent is that which is due to irritation of the mucous membranes.

Many difficulties stand in the way of proving the existence of reflex function as a pure and absolute sympathetic operation; for of all phenomena it is one in which illustrations are apt to be fallacious, and in which even a microscopical examination may be repudiated as establishing the negative fact on which the theory rests.

And yet our daily experience gives undeniable evidence to the fact; and it is satisfactory to feel that the more we study the experiments of Professor Bernard and Dr. Brown-Séguard, which tend to show that the blood-vessels and secretory organs are dependent on the influence of the sympathetic nerves, the more satisfactorily may we explain the phenomena of reflex action.* By such key we seem to be arriving at the knowledge that reflex paralysis is due to the action of the vaso-motor nerves on the vessels either of the nervous centres, or of the palsied muscles, depriving them of the nutrition which is necessary for the performance of their function. Do we require familiar instances of such reflex action?

A momentary sense of shame or excitement, probably by reacting on the vaso-motor nerves, causes the minute vessels of the face and neck to be instantaneously injected with blood; an outburst of passion or a sudden fright produces a deadly pallor of the face, a transient suspension of breathing, a faltering of speech, and, it may be, syncope: mental anguish gives rise to a gushing of tears; or it may cause every limb to tremble, and every bodily function to be more or less affected, and, eventually, bring on some permanent and fatal disease of the brain. All these are instances in which the sensorium takes the place of an outside agent, and acts as an incident nerve in transmitting its impressions to the roots and branches of the motor nerves.

Another example of the operation of mental and moral causes on the animal functions, and one which is more in harmony with our subject, is the emotional paralysis which is sometimes, though seldom, observed in persons who have sustained some powerful or exciting emotions of the mind. A paper on this subject by Dr. Wiblin† is an apt illustration.

* It is but an act of justice to Mr. Lister to observe here, that as early as 1857 he demonstrated the fact that the contraction of the arteries of a frog's foot's web are regulated by a part of the spinal cord, the irritation of which induces complete constriction of the vessels, while its destruction is followed by permanent dilatation. — See Joseph Lister, Esq., "On the Early Stages of Inflammation,"—"Proceedings of the Royal Society," June 1857.

† The above paper was read before the South Hants Medical and Chirurgical Society by Dr. Wiblin, the president; and it is reported in the "Lancet," Aug. 11, 1860.

CASE 74.—The subject of the affection was a gentleman, aged 53, of robust constitution. For some days previous to the attack he had been observed to be exceedingly desponding, and on the morning of the attack some trivial matter of business gave origin to strong mental excitement, which was followed by a sudden incapability of articulating a single syllable : his pulse, 110, was full and bounding, his face flushed, he had great heat of the scalp, and his mouth was drawn to the right side. He participated in the alarm of those who were around him, and on being questioned as to his condition, of which he was painfully cognizant, he burst into a fit of sobbing and crying. He could put out his tongue with difficulty ; but it was foul, tremulous, and directed to the right side of the mouth. He had perfect control over the movements of the upper and lower extremities ; and when asked if he was suffering from any pain, directly placed his left hand over the left side of the head. He walked firmly up two flights of stairs to his bedroom, undressed himself, and, unassisted, got into bed. A blister was applied to the nape of the neck, a brisk purgative administered, and ice was kept applied to the head. He passed the night in a comatose condition, and in the morning his bowels were freely relieved ; but his head was still hot, his face flushed, and although quite conscious of his state, he could not speak. He could express his desires in writing, however, and continued to do so for three days, when, after great efforts to speak, he was enabled to articulate “yes” and “no.” On the fourth day, after a tranquil sleep, he could articulate and swallow better than he had done before, but gave his attendants to understand that he had no sensation above the right angle of the mouth ; nor could he control the right angle of the orbicularis oris, as was evidenced whilst lying on his right side by a constant dribbling of saliva on the pillow. His articulation, however, improved every hour, and on the 18th day from the attack he joined his family dinner, although some want of motion and sensation in the right angle of the mouth still remained.

The following example fell under my own observation :—

CASE 75.—Mr. A., a clerk in the Bank of England, aged 37, of a nervous and excitable temperament, after great anxiety of mind concerning his family, was observed by his wife, on rising in the morning, to have his mouth drawn towards the left side ; and on applying his hand to his face, he discovered that he was insensible to the impression of touch over the entire right side of the face. He had no previous headache, nor was there any other disturbance either of circulation, respiration, or digestion. Under the influence of a blister

to the nape of the neck, the twentieth of a grain of strychnia twice a day, an occasional aperient, and a month's holiday at Margate, the muscular action and cutaneous sensibility of the right side of the face were completely restored.

The structural lesion which, doubtless, supervened as a result of mental excitement, takes from the above cases one characteristic of pure reflex action; but it is obvious that the paralysis, in each instance, was occasioned by a sympathetic disturbance of one part of the brain in consequence of an antecedent disturbance in another: therefore, whether there be organic disease or not, and whether the symptom be simply loss of speech, or whether it be hemiplegia of one entire half of the body, which is sometimes observed in emotional paralysis, the phenomenon is equally dependent on reflex action.

Dr. Budd has related a very curious case of reflex paralysis which occurred three times in the same individual, each time after protracted exertion and great bodily fatigue.

CASE 76.—The subject, John Lang, aged 43, a man of temperate habits, became gradually crooked in the back without any known cause. At the age of 18 he first became paraplegic, but regained the perfect use of his legs at the end of about two years. The paralysis returned twice—first after an interval of twelve years, and again after two more,—each time, as I have before stated, after protracted exertion; but on the two last occasions it continued only a few weeks. The curvature of the spine had not increased since his first attack, and in the intervals his health was good. The curvature is described as of an antero-posterior character, without any lateral deviation, forming a large projection, and compressing the dorsal vertebræ from the fifth to the eleventh inclusive.

Sensation in the lower half of the body began to fail at the umbilicus, and was very much impaired immediately below. In the legs it was nearly extinguished. Reflex action, however, was vigorous; so that a feather passed lightly over the skin in the hollow of the foot caused active convulsions of the corresponding leg; and when asked if he felt anything, the patient replied, "No, I feel nothing; but you see my leg feels well enough." *

If we may regard this latter case as one of reflex action, it is, like the two former, exceptional in having a central origin,

* "Medico-Chirurgical Transactions," vol. xxii.

and in being characterized by anæsthesia, which is rarely a symptom of reflex paralysis; and yet the anatomical structure of the spinal cord would lead to the *à priori* inference that sensory nerves might reflect their morbid impressions on other sensory nerves as well as on motor nerves. They do, in fact, frequently induce paralysis of the nerves of special sense.

Pregnancy is sometimes a source of reflex paralysis. It occasionally happens that temporary blindness, or the incapacity of expressing what is desired, or even absolute loss of speech, occurs. Sometimes it is paraplegia, sometimes hemiplegia—usually the latter—and sometimes anæsthesia of some portion of the body, that manifests itself; and it mostly occurs during the early months—sometimes, however, at a later period of utero-gestation. Dr. Churchill, of Dublin, has collected and published many such cases. This sympathetic disturbance generally goes off before delivery; therefore, there is seldom an opportunity of demonstrating the non-existence of physical change in or about that portion of the nervous centres on which the loss of function depends; but it is probable that a morbid impression is conveyed to the cerebro-spinal axis by branches of the sympathetic nerve, and, by a reflex action on the blood-vessels through the vaso-motor nerves, that a change of nutrition is determined in such portion of the nervous centres whereby the various forms of paralysis are produced.

This appears to me the most rational explanation of those cases to which Dr. Handfield Jones has given the name of neurolytic paralysis;* cases in which, from no very adequate cause, a connecting link between the organ of volition and the organ of motion is for a time destroyed, but which is generally regained by the action of nervine tonics. There are, however, in all these cases, certain antecedent circumstances which lead to the inference that a morbid influence has been conveyed to and concentrated upon some portion of the cerebro-spinal system, whereby the functional working of the ganglionic cells of the motor nerves is temporarily suspended.

Two opposite instances are given in the paper to which I

* "British Medical Journal," Sept. 7, 1861.

have referred, and Dr. Copland has recorded a case illustrative of the subject.*

CASE 77.—A gentleman, on his voyage across the Atlantic to this country, in the winter season, was seized with general palsy of the powers of voluntary motion immediately after prolonged exposure to cold and wet. The functions of the brain were unaffected; and neither pain nor uneasiness was felt in the neck, or in any part of the spinal column, under any circumstances of position, flexure, rotation, or pressure. No evidence of inflammatory action or of congestion in the spine could be detected. Cutaneous transpiration was suppressed, and the bowels were costive and torpid; but he retained the sensibility of the surface, and command over the sphincters. He was treated at first upon the supposition of either serous effusion or vascular congestion having taken place in the spinal canal, but without receiving any benefit. He ultimately recovered by having frequent recourse to warm baths containing stimulating substances.

Therefore, although we may think and speak of reflex paralysis as a purely sympathetic operation, it is, I think, not too bold an assumption to attribute the paralyzing influence to a change of nutrition in the sensory or motor centres. Nor can the absence of apparent change be accepted as positive evidence that none existed in fatal cases of reflex paralysis; for it is possible to conceive of the delicate nerve-tissue as subject to injurious pressure in consequence of vascular turgescence during life, of which no trace may be left after death. Hence much caution is necessary in the establishment of a pathological principle, seeing that we may regard as purely functional that which is dependent on some physical change. And we can the more readily appreciate the need of such reserve after contemplating the effects of an impure blood circulating in the nervous centres. Cold and wet, for instance, generally figure in these cases of neurolytic paralysis as the antecedent or exciting causes: and where shall we look for a more prolific source of irritation of the mucous membranes? There we have a starting-point from which afferent nerves convey the morbid impression to the nervous centres, where a physical change is induced in or about the nerve molecules, which may

* "Dictionary of Practical Medicine," art. Paralysis, sec. 76.

not be discovered after death, but on which reflex paralysis may depend.

Still, cases do occur illustrative of the condition of reflex paralysis as above stated, which are subordinate to no other classification, and which, therefore, justify a separate subdivision. Evanescent amaurosis, for instance, is often produced as a reflex action from the irritation of worms in the intestines. Of this phenomenon M. Davaine has recorded twelve instances in his treatise on Worms. And I remember a case which fell under my observation many years ago, but of which I have not the precise details, of a lady, aged about twenty-six, who had been married five or six years, but had no family. For some two or three years she had suffered from extreme debility, and had observed, at various times, pieces of tape-worm to pass from her. After a full dose of the oil of turpentine, the entire worm was ejected; she regained strength very rapidly, and became pregnant in a few months. Such also are those instances of acinesia in children which occur suddenly, without any premonitory indications, and almost as suddenly disappear.

CASE 78.—Miss E. R., aged 14. After a year's residence in England, having before lived in Oporto, was suddenly seized with pain in the abdomen, a sense of sickness, dragging in both groins, and with partial acinesia of the right arm. On the following day she passed an *ascaris lumbricoides*, and a few hours after she regained the power of the arm. Between the months of September and June, four more worms passed with exactly the same symptoms and the same result.

In this case the morbid impression upon spinal nerves through the intervention of the spinal cord was conclusively manifest; and if the cord could have been examined, it is probable that no change from the healthy condition could have been observed. The case, moreover, is suggestive of a relationship between centripetal nerves and definite motor tracts in the nervous centres; but in few cases of *infantile paralysis* is the exciting cause so obvious, or the suspension of the effect so speedy.

I have notes of a very interesting case which fell under my

observation in 1858. The subject was a patient of Mr. Lucas, of Barwell, who kindly supplied me with the following details.

CASE 79.—R. C. G., aged 5 years, shortly after returning from the sea-side, was seized with diarrhœa and sickness, which continued a day or two, and subsided under the influence of appropriate remedies. In about ten days or a fortnight, the child could not sit up at table, without a pillow to support his head. On careful examination, the whole of the left side of the body was found to be very weak, and the left leg perfectly paralyzed. There was also strabismus, but that was congenital. The parents were quite certain that the child had never fallen, or in any way been injured.

Thinking that he might have worms, I gave him a powder, twice a week, consisting of calomel, jalap, and scammony, but without effect, as no worms were found, although the bowels were freely evacuated. The spine was then repeatedly blistered, and the paralyzed limb was rubbed twice a day—twenty minutes each time—with the linimentum terebinthinæ; under which treatment he gradually recovered the use of his leg. It was interesting to observe how gradually he regained the use of parts; first of the head and upper extremities, then the muscles of the back seemed to acquire power so that he could sit. The muscles of the thigh next enabled him to swing his leg, then he could move the leg; after which he acquired power over the ankle joint, and eventually he moved his toes. By similar stages the power of locomotion returned also, so that from being able to sit, he soon began to crawl; then to support himself and move by crutches, next by means of sticks; and by slow degrees he regained the faculty of independent motion.

Some of these cases, however, are so indicative of a central cause that they would seem to claim a special pathology of their own; and although irritation from teething, worms, and other intestinal disturbances, is so common as to suggest and appear to justify the idea that all cases of infantile paralysis are due to such causes, yet, in point of fact, how many instances do we see in which no such antecedent irritation has been observed, and which are referable only to structural lesions depending upon inflammation or other nutritive changes in the nervous centres!

Such cases have been recorded by Dr. Wilks, of the Royal Infirmary for Children;* and Dr. West† has described many

* "Lancet," April 18, 1863.

† "Lectures on Diseases of Infancy and Childhood," London, 1854.

others; and it is difficult to imagine that acinesia should occur suddenly, *without any previous symptoms*, unless idiopathic disease of the brain or spinal cord were the cause. It sometimes happens, for instance, that a child will be put to bed in apparent health, and be taken up in the morning with an arm or leg paralyzed. A case of this kind is related by Dr. Handfield Jones,* which is pre-eminently suggestive of some central cause.

On the other hand, we meet with many instances in which the excitability of the nervous system is so great that what begins as sympathetic functional disturbance ends in structural lesion; and such is the natural course of disease.

CASE 80.—C. J., aged 5 years. When I first saw him he had suffered much from teething, and had recurrent paralysis of one arm or the other with each tooth that he cut, but subsequently regained the power of moving the disabled limb. After about eighteen months of such periodical suffering, his head was observed to increase in size; he would roll it on his pillow, and often wake with a scream. In 1849—three years from the first attack of paralysis—he died of hydrocephalus.

A due regard to this *natural history of disease* will, I think, elucidate the nature of many cases of genito-urinary paralysis on which much diversity of opinion has been expressed within the last few years.

On the one hand it has been asserted—1. That an outside excitation, starting from the periphery or trunk of a nerve of the genito-urinary organs, transmits sensitive impressions to the spinal cord, although that nerve may not be excitable or able to give origin to sensation; and having reached the nervous centre, those impressions are reflected either on the blood-vessels of that very centre, or on those of the motor nerves or the muscles, and so cause reflex paraplegia. 2. That this reflex paraplegia is characterized by the absence of the special symptoms of an organic disease of the spine or its contents, and by the existence of an incomplete paralysis of the lower limbs appearing slowly after the manifestation of disease of the

* "British Medical Journal," Sept. 7, 1861.

urinary or genital organs.* 3. That when the outside excitation ceases altogether, the reflex paralysis generally ceases altogether also, and in a short time.

On the other hand, it has been maintained—1. That reflex paralysis from disease of the genito-urinary organs does not rest upon unequivocal evidence. 2. That the true order of morbid processes is not always that which they superficially present to our notice, and that the urinary affection is not the cause, but the consequence of disease in the nervous centre. 3. That for the purpose of maintaining the theory of urinary paralysis mere muscular weakness has been exaggerated and made to appear as paralysis.†

Mr. Stanley first suggested the influence of kidney disease in the production of irritation of the spinal cord,‡ but no case hitherto reported illustrates the fact more satisfactorily than the following, —treated by Dr. Gull,—who, admitting the existence of urinary paraplegia, is disposed to think that it is generally the result of myelitis.

CASE 81.—Henry P., aged 32, clerk to a solicitor. Admitted into Guy's Hospital, under the care of Dr. Gull, Dec. 23, 1857. He was a tall, well made, rather pallid, but otherwise healthy looking man, suffering from entire paraplegia of the lower extremities and sphincters, but without any affection of sensation. Two years before he fell in attempting to jump over some chairs, but a few days after all apparent effects of this accident passed away, and he considered himself in unimpaired health. In the summer of 1857 he married, and indulged excessively in sexual intercourse. * He was otherwise temperate. For two or three months preceeding the sudden development of the paraplegia, he experienced at times some difficulty in micturition. Urethra healthy. On the 9th December, there was numbness of the extremities extending as high as the knees, but this was so slight as not to attract any attention at the time. On Monday, the 14th, he walked as usual from the suburbs to his business in the City. About the middle of the day, as he was

* "Lectures on the Diagnosis and Treatment of the Principal Forms of Paralysis of the Lower Extremities." By C. E. Brown-Séquard, M.D., p. 42.

† "Guy's Hospital Reports," Third Series, 1861; p. 392.

‡ "On Irritation of the Spinal Cord and its Nerves, in connexion with Disease in the Kidneys."—"Medico-Chirurgical Transactions," 1833; vol. xviii., p. 260.

crossing his room, his legs suddenly became weak, and he would have fallen had he not been supported. After a short time he recovered sufficiently to walk, with some difficulty, to the omnibus, and afterwards from the omnibus to his home. In the course of the afternoon he became entirely paraplegic, the urine and fæces passing involuntarily from him. There was no affection of the upper extremities, except slight and transient formication in the hands. On admission on the 23rd, there was a trace of excito-motor activity in the left leg, none in the right. No appreciable diminution of sensation. Movements in the chest normal. Pulse 120, feeble. Pupils dilated. Surface of the trunk and upper extremities warm and perspiring. Legs cold. A sense of tightness round the chest, about the attachment of the diaphragm. Bowels inactive. Urine drawn off by catheter. The next day œdema of integuments in the lumbar regions, especially on the right side. On 26th this had disappeared. Spine normal. No change in the paralytic symptoms. Occasional slight involuntary twitchings of the legs. Electro-contractility of the muscles good. Only the slightest trace of excito-motor action, and that limited to the left leg. The integuments over the sacrum reddened. Pulse 130. Skin hot and dry. Urine ammoniacal, and containing a large quantity of very offensive mucoid pus. The passage of the catheter was followed by much bleeding. During the night of the 28th, nausea and vomiting came on, with great prostration. Respiration thoracic. Death from exhaustion on the morning of the 30th.

EXAMINATION. — Head not examined. About the base of both lungs, commencing acute lobular pneumonia. Lung tissue otherwise healthy. Heart healthy. Intestines covered by recent inflammatory exudation. Mucous membrane of bladder sloughing; its muscular coat and pelvic areolar tissue infiltrated with fetid pus and urine. Two false passages, one passing through the prostate and thence into the bladder, the other passing into the areolar tissue behind it. No stricture of the urethra. Texture of kidneys healthy. No trace of old or chronic disease could be discovered, either about the pelvis, in the pelvic viscera, or in the bodies of the vertebræ. No phlebitis. Membranes of the cord healthy. As the finger was passed lightly along the body of the cord it appeared to be somewhat softened at two points, in the middle and at the lower part of the dorsal region; but on the most careful microscopical observation nothing abnormal was discovered in the texture either at these parts or in any other, though the cord was submitted to repeated and searching examination by the microscope. The epithelium lining the ventricle of the cord on the lower dorsal and lumbar regions was abundant, but normal. A few granules of brain-sand were found in the posterior columns,

about the middle of the dorsal region. No traces of inflammatory exudation anywhere, either in the cord or in its membranes, nor any evidence of degeneration of the nerve tubules.*

Ramollissement of the substance of the cord was suspected during the life of the patient; but ramollissement is rarely found where pain has not previously existed, especially in so young a subject, and no disorganization was discovered after death. Acute tabes dorsalis was also suggested by Mr. Durham, who reported the case; but tabes dorsalis seldom, if ever, exists without loss of sensation; neither was there any deposit of adventitious fibroid tissue found, notwithstanding the most careful microscopical investigations.

The order of antecedence of symptoms pointed to the urinary organs as being first affected, and the *post mortem* examination proved that such was the case, and that the spinal cord was suddenly deprived of its function without any appreciable amount of anatomical lesion. We are the more encouraged to believe that no structural change of the cord did exist, because Dr. Gull has so strongly insisted on the mistrust with which we ought to look upon evidence which the unassisted eye supplies, and after several hours spent in the examination he failed to discover anything abnormal; but in a case to which I have already referred,† extensive disorganization *was* discovered by means of a lens of an inch focus, whilst “*the cord had the normal size and appearance, and neither to the touch nor on section presented any obvious softening.*”

Any one who has witnessed the profound shock to the nervous system which injudicious catheterism is capable of producing in cases of stricture, will be prepared to see in the amount of disease above described in the bladder and prostatic portion of the urethra, an adequate source of reflex paraplegia. Remembering that the nervous centres have blood-vessels provided with vaso-motor nerves on which the peripheral irritation may be reflected, he will readily conceive how any part of the cerebro-spinal axis may be suddenly deprived of that quantity of blood which is essentially necessary for its healthy function.

* “Guy’s Hospital Reports,” Third Series, vol. iv.

† “Medico-Chirurgical Transactions,” vol. xxxix., p. 196.

As is the bladder so are the kidneys incitive to reflex paraplegia. Dr. Brown-Séquard affirms that he has seen a contraction of the blood-vessels in the pia mater, when a ligature was tightened on the hilus of the kidney;* and M. Comhaire has shown that extirpation of a kidney in living dogs is instantly followed by paralysis of the legs.† Many cases of reflex paraplegia, the result of nephritis, have been recorded by M. Rayer;‡ and Sir Benjamin Brodie, in his "Lectures on the Diseases of the Urinary Organs," relates the case of a man who swallowed a large quantity of tincture of cantharides by mistake, and who suffered from ischuria and paraplegia in consequence; but in this instance some spinal disease was set up, as it was more than four years before the man could walk with crutches.

In renal disease paralysis may be caused by uræmic poisoning of the blood, when cerebral symptoms generally supervene; and it was chiefly in relation to such circumstances that I ventured in a former page (p. 106) to comment on many of Dr. Abercrombie's cases. So also may inflammation of the kidneys extend to the lumbar and pelvic cellular tissue, and produce paraplegia by implicating the lumbar and sacral plexuses of nerves; or the inflammation may extend to the lower portion of the spinal cord and its membranes. The pelvic arteries also may be involved in the diseased action, and cease to convey to the sacral plexus of nerves, and to the muscles of the thigh, an adequate supply of blood for healthy nutrition.

In these latter cases there is generally anæsthesia, which rarely exists in reflex paraplegia. There is also an absence of those variations in the degree of paralysis, corresponding with the increase or decrease of the exciting cause, which characterizes reflex action.

When, however, the paraplegia is dependent on reflex irritation, it is most complete in the limb of the side corresponding with the kidney which is most diseased, a phenomenon which admits of a ready explanation by the experiments of Dr. Brown-Séquard, who has shown that contraction of the blood-

* "Lectures on the Diagnosis and Treatment of Paralysis of the Lower Extremities," p. 24.

† "Dissertation sur l'Extirpation des Reins," Paris, 1803.

‡ "Traité des Maladies des Reins," etc., vol. iii.

vessels of the spinal cord is most evident on the side corresponding with the irritated afferent nerves.*

This latter peculiarity is obviously applicable to those cases only in which reflex paralysis is due to double organs. But it has been shown that peripheric irritation may have its starting point from any incident nerve in the body, and that, consequently, there is no organ which may not be the exciting cause of well marked reflex palsy, varying, however, in degree according to the variation in the intensity of the outside excitement. This liability to vary may be said to be a law of reflex action.

The uterus, exercising as it does a sovereignty and control over all other organs, is a prolific source of reflex paralysis. M. Lisfranc has recorded the case of a lady who had for a long time been under treatment for myelitis, but who quickly recovered the power over a palsied leg, and regained her health when treated for metritis.† An instance of reflex paraplegia, from uterine irritation, occurred in the practice of my friend Dr. Hunt, and it has been often quoted as illustrative of reflex action. Portal also relates the case of a strong fat woman who had convulsive movements of the left leg whenever she menstruated. At the age of forty that function ceased, and the left leg became completely paralyzed. Bleeding, blisters, and other remedies were useless, and she was on the point of going to the waters at Bourbonne, when she was suddenly seized with convulsive movements of the left arm. She quickly became comatose and died.‡

In this case it is obvious that the uterus was the source of irritation, and that myelitis was the result, for the spinal cord was found to be soft and red.

Dr. Brown-Séquard reports a case of dysmenorrhœa in a young lady, with antifixion of the uterus, which was extremely sensitive, very large, congested, &c. She had extreme weakness, amounting to almost complete paraplegia at each menstrual period. This had lasted six months, and had been treated by strychnia, galvanism, shower baths, steel, &c., without effect;

* See pages 20, 21.

† "Clinique de Pitie," vol. ii., p. 192.

‡ Vol. iv., p. 116.

but in a few days relief was obtained by supporting the womb by means of a bandage, and in less than two weeks the paralysis entirely ceased.*

Numberless instances might be brought forward to show that reflex paralysis may be induced, as before stated, by a primary irritation of any part of the body; but as the fact is now universally admitted, it is useless to swell these pages with more examples. Let us, therefore, proceed to consider the diagnostic signs of those cases of reflex paralysis in which it is assumed that no anatomical lesion of the nervous centres exists.

DIAGNOSIS.—Notwithstanding all that has been urged relative to the uncertainty of the true order of morbid processes, a knowledge of every circumstance under which paralysis appears is, if possible, more necessary than an insight into the order of antecedence of symptoms in any other form of disease; and the following connotations are characteristic of reflex paralysis, as distinguishable from paralysis depending upon organic disease of the nervous centres or their investing membranes:—

1. It is preceded by symptoms indicative of an affection of some other part of the body.
2. It generally varies in degree, according to the variations in the exciting cause.
3. It is usually incomplete, some muscles being more paralyzed than others.
4. It is seldom accompanied with spasms in the paralyzed muscles.
5. The pains in the course of the spine; the formication, flying pains, and pricking sensation, described in cases of myelitis, do not appear in reflex paralysis.
6. There is seldom anæsthesia.
7. The excitomotor power of the paralyzed muscles is generally retained.
8. Convulsive movements are not so apt to be excited by defecation and micturition as they are in myelitis.
9. The restoration to healthy power is often rapid after removal of the exciting cause.

* "Lectures on the Diagnosis and Treatment of Paralysis of the Lower Extremities," p. 11.

In the above phenomena my observations have entirely corresponded with those which Dr. Brown-Séquard has detailed* as distinguishing reflex from centric paralysis. In addition he insists on the following indications as characterizing the difference between paraplegia due to reflex influence from the urinary organs and the paraplegia due to myelitis.

Urinary Paraplegia.

1. Preceded by an affection of the bladder, the kidneys, or the prostate.

2. Usually lower limbs alone paralyzed.

3. No gradual extension of the paralysis upwards.

4. Bladder and rectum rarely paralyzed, or at least only slightly paralyzed.

5. No feeling of pain or constriction round the abdomen or the chest.

Paraplegia from Myelitis.

1. Usually no disease of the urinary organs, except as a consequence of the paralysis.

2. Usually other parts paralyzed besides the lower limbs.

3. Most frequently a gradual extension of the paralysis upwards.

4. Bladder and rectum usually paralyzed, completely or nearly so.

5. Usually a feeling as if a cord were tied tightly round the body at the upper limit of the paralysis.

After cerebritis in children paralysis sometimes ensues, and it may have the peculiarity of appearing to change places from time to time, corresponding with the greater intensity of the inflammation in one side or the other of the brain. Thus, one day one arm and leg may be paralyzed, and the day after the limbs of the opposite side; but in these cases squinting and convulsions will precede and accompany the paralysis, whereas in reflex paralysis convulsions are never observed.

PROGNOSIS.—The prognosis depends on the seat and intensity of the cause on which the paralysis depends. It often appears more dangerous than it is, but a due consideration of the order in which the symptoms appear, and a just appreciation of the symptoms of the disease of which the paralysis is an accident, will greatly assist in the prognosis.

* Op. cit., pp. 33, 34.

Those cases are, of course, most hopeful wherein the paralysis can be traced to a peripheric cause, which admits of quick relief. Thus the amaurosis or acinesis produced by worms, is generally removed with the removal of the source of irritation.

When the paralysis comes on slowly, and changes with the cause which has produced it, the prognosis is more favourable than when it appears suddenly, as it is apt to do from cold and diseased kidneys, and continues long after the exciting cause has been removed. In this latter case the nervous centres are liable to become affected by extension of diseased action to the nervous and vascular tissues.

As a general rule, the prognosis of reflex hemiplegia is more favourable than that of reflex paraplegia.

When the paralyzed muscles suddenly diminish in volume, and become flabby, it may be inferred that they are deprived of an adequate supply of arterial blood for the performance of their special function; and that the palsy is dependent on defective nutrition of the muscles themselves. In such cases the prognosis is bad.

TREATMENT. — In all these cases it is useless to treat the paralysis, which is an accidental effect, without the administration of suitable correctives to the exciting cause. Therefore, whatever may be the outside irritation, our first endeavour should be to alleviate and subdue it.

Whilst this is being accomplished, the morbid impression made on the incident nerves should be allayed by the local application of an efficient sedative, and belladonna is the best; for it acts principally upon the cerebro-spinal system by depressing, or abolishing if used in sufficient quantity, the functions of the different parts of that system successively; the sensitive and motor apparatus being the first to be affected; the organs of intellect the last.

Now, if it be true that reflex paralysis is due to a morbid contraction of the vessels of the nervous centres, or of the palsied muscles, and there is great reason to suppose that it is, the great indication of treatment is to re-establish the normal calibre of the contracted vessels, so that by restoring the amount of blood to the palsied organs, we may resuscitate their vital energy.

The experiments of MM. Martin-Magron and Buisson* tend to show what experience confirms, that this last object is obtained by no therapeutic agent so effectually as by strychnine; that the molecular organization of nervous structure answers best to this specific stimulus which, according to the opinion of Dr. Brown-Séquard, acts not in the same way as galvanism, but (1) "by increasing the amount of blood in the spinal cord; and (2) by acting in a special and direct manner on the tissue of the cord."

The application of galvanism in these cases demands great forethought; for, as Dr. Marshall Hall suggested, "in passing a current through the spine, you merely transmit an influence or power (irritability) which it already possesses," and if Pflüger be right, the only effectual current would be so powerful as to suspend the action, or even cause the death of the nerve molecules. To the palsied muscles themselves a galvanic current, applied as Duchenne has recommended, may act as a preservative excitant.†

In the employment of external applications to allay irritation or for the purpose of stimulating weakened muscles to increased action, the interesting observations of Van der Kolk may be of great service. "The sensitive branches of a spinal nerve," says he, "run to the part of the skin which is moved by the muscles receiving motor filaments from the same nerve trunk." In other words, a spinal nerve gives its motor branches to the muscles as instruments, and its sensitive branches to the parts moved. If this be so, our local remedies should be most effective, when applied as either sedatives or excitants to those incident nerves which are bound up in the same nerve trunk with, and transmit their impressions most directly to the motor nerves of the palsied muscles. And Van der Kolk affirms that it is so. That by tickling the palms of the hands the fingers are bent, and by tickling the backs of the hands the fingers are extended; that by friction of volatile liniments to the back of the hand he has seen powerful contraction of the fingers overcome, and the involuntarily flexed arm extended by similar

* "Journal de la Physiologie de l'Homme," etc., Nos. vii., viii., 1859; and ix., x., 1860.

† See page 35, note.

frictions on the back of the fore-arm. The application of cold and heat to the spine, as recommended by Dr. Brown-Séquard, may be advantageously used; and the fact, which he has observed, that the temperature of one hand is sensibly increased by the immersion of the other hand in hot water, may serve as a valuable hint in the local treatment of reflex paralysis.

It has been suggested that strong mental emotions may be sometimes justified during convalescence, and a case is often quoted which Boerhaave related of a favourite sultana, who was cured by a violent effort to oppose her physician's attempt to touch her feet, which no modest Turkish woman would permit.

Sulphureous mineral waters are highly esteemed on account of their stimulating influence on palsied muscles, and their employment as a bath should never be neglected when reflex paralysis does not disappear with the cause which produced it.

CHAPTER VI.

PROGRESSIVE FORMS OF PARALYSIS.

THERE are three forms of paralysis, which, from their slow and unyielding course, have received the significant epithet *progressive*, although the etiology of the three differs as widely as do the concomitant circumstances under which they appear.

Dr. Calmeil is disposed to think that in about one-fourth part of the number of those unfortunate individuals who enter our lunatic asylums, a chronic inflammation of the meninges and of the cortical part of the brain exists, which sooner or later leads to the condition known as

*The Progressive Paralysis of the Insane.**

During the stage of mental aberration which precedes the palsy, it generally happens that every natural feature of the patient's character is completely reversed: the modest, unobtrusive man becomes proud and vainglorious; and it is chiefly in persons labouring under this especial form of insanity that paralysis is apt to occur. Next in order to them come the melancholic. The male sex is far more liable to be affected with palsy than the female, in the proportion of at least four to one; hence, at the Bicêtre, in Paris, paralysis is of much more frequent occurrence than at the Salpêtrière, where females only are admitted.

The first indication of the disorder is detected in a difficulty in pronouncing words, especially the final syllables, the utterance of which is imperfect and effected with trembling lips. The tongue, too, when protruded, is tremulous. The labial

* “*Traité des Maladies Inflammatoires du Cerveau*,” par le Dr. L. F. Calmeil, tome i., p. 261.—The above disease was first accurately described by Bayle and Calmeil in 1837.

sounds are apt to be the most defective at first, but as the palsy progresses, every muscle of the mouth and tongue becomes more or less affected, and every syllable bears evidence to the fatal progress of the insidious disease. Occasionally the symptoms of failing power first manifest themselves in the legs or arms, but the peculiar failing of speech is, in the great majority of cases, the earliest indication of the existence of the special form of paralysis; and so shadowy is its advent, that, as Dr. Wood has observed in an excellent paper on the subject, "until it has made fatal progress, it can hardly be said to exist."*

In a short time after, the muscles of the trunk and limbs betray a weakened condition by the unsteady, uncertain gait, and by the awkward movements of the hands and arms. Still the patient will go on walking as if nothing were the matter, and using his hands, though clumsily.

In this stage of the disease great variations are observed in both the intellectual and physical powers. For days or weeks the patient will be rational and very particular as to his dress and behaviour: after an embarrassed speech and a laborious walk, he will talk with ease and walk a great distance without fatigue; but suddenly, and without any apparent reason, the articulation of words becomes more difficult than ever; and in walking the feet are scarcely raised from the ground, so great is the weakness. The body, too, is inclined either forward or to one side; and so increases the appearance of uncertainty in progression. The successive degrees of weakness proceed equally on both sides of the body, but sometimes one side is observed to be much more infirm than the other. Notwithstanding this decay of physical power, the victims of the disease labour under the insane but happy conviction that they are hale and strong.

At about the mid-stage of the disease the rectum and bladder are apt to become involved in the paralyzing influence, the muscular coats of those organs being in some cases implicated, so that assistance must be given in defecation and micturition, or the sphincters participate in the paralysis, and incontinence of urine and of the contents of the bowel results.

The special senses are in most cases deadened, and sometimes

* "British and Foreign Medico-Chirurgical Review," vol. xxvi., pp. 175—201.

entirely lost, together with the loss of speech ; and in almost all insane persons the general sensibility of the surface is considerably diminished ; for they are obviously less sensible to pain than healthy individuals.

To the expert, therefore, the first difficulty of pronunciation, the awkward use of the fingers, and the unsteady walk, foreshadow the hapless condition of fatuity and uncleanness in which man becomes in every respect a more degraded being than the brute of the field, unless mercifully he may be carried off by some accidental and less loathsome disease, to which the insane are peculiarly liable.

Throughout the whole course of the disease the paralyzed muscles contract under the influence of galvanism.

In at least one-fourth of the subjects of this form of progressive paralysis there is an undoubted hereditary tendency to some form of cerebral disease ; but the special lesion which is the cause of the paralysis in question is a diffused chronic inflammation of the meninges, and of the superficial surface of the brain. Calmeil asserts that wherever the process of inflammation is most apparent, there the pia mater is intimately connected with the cortical surface by means of tufts of capillary vessels, and that in attempting to separate the two, a portion of the brain is apt to be torn away with the pia mater.*

The convolutions of the cerebrum in and about the fissure of Sylvius, the inferior surfaces of the anterior lobes, the surfaces on the sides of the falx cerebri, the corpora striata, the optic thalami, and corpora ammoni, the upper and lower surfaces of the cerebellum, and the grey substance of the pons Varolii, are the parts most frequently found to be implicated in the structural lesion ; but, according to M. Joire, molecules of granular matter are generally found in the walls of the fourth ventricle ; and if this be so, we have at once a physical cause for the difficulty in pronouncing words. Calmeil has also observed that this granular matter is made apparent, by the assistance of the microscope, on the inner side of the pia mater, in the vesicular grey substance, and also as forming an incrustation around the larger vessels in the white fibrous substance of the brain.†

* Vol. i., p. 263.

† Vol. i., p. 268.

The variations which occur in the intensity of the symptoms are doubtless attributable to temporary lulls and subsequent extensions of the inflammatory action. Like the simple form of chronic inflammation of the brain, the natural course of the disease is characterized by irregular remissions and exacerbations.

If the patient were placed under medical treatment when the first symptoms of excitement appear, the disease might probably be arrested; but it is just at that period when he is most unconscious of suffering, and most obstinate in his refusal to submit to medical advice. When the earliest indications of paralysis have once appeared, the disease is incurable by any means which we at present know of.

In the earliest stage of this diffused chronic inflammation the antiphlogistic system, carefully administered, promises the happiest result. Leeches applied to the perinæum, the nostrils, or behind the ears, when the occasional exacerbations occur, together with purgatives, according to the exigencies and indications of the case, are our great resources; counter-irritants, stimulating foot-baths, and evaporating lotions to the head.

During the remissions the tepid or cold shower-bath, together with light tonics, tend to invigorate and support the patient's strength; but we should watch carefully each successive exacerbation, and carefully apply the antiphlogistic means, modified, of course, according to the urgency of the symptoms, although it be but to prolong the miserable existence of the patient.

Morphia to produce sleep, and stimulants to support the progressive loss of nervous power, together with such nourishment as can be borne without the risk of exciting inflammatory action in the brain, are the remedies on which those who are most familiar with the disease place the greatest amount of reliance.

Progressive Ataxia.

Another form of progressive paralysis was first described by Dr. Duchenne, of Boulogne, under the name of *ataxie locomotrice progressive*.

The disease is often preceded by acute evanescent pains, which

have been described as nervous rheumatism, in the extremities—in the legs more frequently than in the arms, but sometimes in the body, face, and head—pains which are induced by the least amount of bodily fatigue or mental excitement, and which occasionally increase in intensity as the paralysis advances, eliciting more complaint than is made of the failing power. In some instances the pain has been known to continue permanently.

In the majority of cases which have come under the observation of M. Duchenne, a paralysis of either the sixth or third pair of nerves has occurred at an early period, giving rise to diplopia of a transitory character, as is diplopia generally, and also with unequal contraction of the pupils.

Another distressing symptom which is specially alluded to by M. Trousseau,* as the harbinger of this affection, is incontinence of urine, associated with spermatorrhœa during the night. Now, although anaphrodisia is found to coexist in most cases of spermatorrhœa, yet in this particular disease there is a great proclivity to satyriasis; and it is no mere impotent desire, for Trousseau speaks of a patient who confessed to having had effective sexual intercourse ten times in the course of twenty-four hours.

Nor is this the only incongruous symptom of a disorder which is characterized by loss of power; for when the patient is in the erect position, the muscles are able to support a great weight; and when seated, to resist considerable force that may be exercised to straighten a bent extremity.

The period, however, at which the general paralysis comes on may be months or even years after the premonitory symptoms above alluded to; and then there is a gradual and progressive loss of the power of co-ordination in the acts of volition. The groups of antagonistic muscles which are required to act consentaneously in the various motions of the limbs cease to do so, and an awkward, unsteady gait is the result.

At first the feet are moved in a slatternly manner, the heels lunging on the ground before the toes; and then, as the disease advances, they are thrown involuntarily to the right and left, without purpose, and without the power of restraining their

* “Clinique Médicale de l’Hôtel Dieu de Paris,” tome ii., p. 185.

irregular movements. As the difficulty of maintaining the equilibrium of the body increases, the patient looks, as M. Trousseau has remarked, like a bad tightrope-dancer; and at this stage the act of turning round is performed with the greatest difficulty. The sensation of the feet is apt to become blunted during this second period of the disorder, so that the patient feels as if he were always walking on a soft carpet, and is, therefore, so much the more insecure.

The third stage is marked by an extension of paralysis, both of motion and sensation, to the upper extremities; and as the power of volition over the motions of the legs diminishes, the moment arrives when it is impossible to attempt a single step in advance without falling. If amaurosis be present, as it frequently is, the want of co-ordination is intensified; for even in the second period the legs are directed more by the sense of sight than by the consentaneous action of a group of muscles, or, as Sir Charles Bell called it, by the muscular sensibility. And now, if the patient be supported and requested to move his legs as if walking, they are thrown about in a purposeless manner, like the legs of an ill-constructed automatic figure. The rectum and bladder are also frequently implicated, as in the paralysis of the insane; but the genital organs may preserve their normal power.

The electro-muscular contractility is retained throughout the whole disease.

The duration of this progressive paralysis is, for the most part, very long. M. Trousseau has recorded a case which passed through its successive phases in six months, but in general the disease will last from ten to twenty years.

In the first stage, the flying, acute pains in different parts of the body coincident with the strabismus may lead to a suspicion of its approach; but no sooner is the faulty co-ordination of muscular movement observed than a special diagnostic sign of invariable occurrence discloses the nature of the disease. Notwithstanding the embarrassment in walking, still the patient will walk great distances without fatigue, and will sometimes tire out good pedestrians; but put him on his legs with his eyes shut and his feet close together, and, although he has the muscular power, he has not the muscular sensibility to preserve

the equilibrium of his body; or direct him to take a few steps forward with his eyes closed, and he will reel and tumble about like a drunken man.

CASE 82.—An apothecary from the west of France presented himself to M. Trousseau, in August, 1861, complaining of a sense of weakness in his limbs and incontinence of urine. He had experienced sudden sharp pains in his legs for a year or more, and had become deaf of one ear. When desired to shut his eyes and walk, he tottered about as though he were drunk, although there was little remarkable in his walk when his eyes were open, and when asked to stand erect with his eyes closed and his feet in apposition, he could not do it.

CASE 83.—A patient applied to M. Duchenne in 1852, in consequence of double vision—diplopia, which was cured by galvanism. Some five or six months after he was seized with acute lancinating pains in the legs, and in 1854 he first became aware of some difficulty in directing his feet in the act of walking. In 1860 he could no longer stand, although he possessed considerable muscular force, but the power of co-ordination was lost.

In all these cases the intellect and speech remain perfect, and in these respects the disease differs from the progressive paralysis of the insane; its creeping progress and gradual extension to the upper extremities, together with the loss of co-ordination, but not of power, give it a distinctive character, and make it to differ from paraplegia, in which both motion and sensation are destroyed.

The number of cases already recorded, tend to show that it is a disease of middle age, that it affects males rather than females, and that, like many other nervous diseases, it is apt to be transmitted from one generation to another. But when it first appears in a family, it always selects for its victim an individual of a house in which nervous diseases predominate over all others.

I say *like many other nervous diseases*, because this is undoubtedly of nervous origin as the following case will testify.

CASE 84.—M. W. aged 38, was admitted into a Maison de Santé, under Dr. Bourdon. At the age of 25 he had epilepsy, which continued about two years, before and during which he drank largely of absinthe, but on discontinuing it the epilepsy left him. When he

was 32, he began to feel some difficulty and uncertainty in directing his legs, especially in going up and down stairs. Some four or five years after, his sight began to fail, and he had occasional attacks of diplopia. A year after this incontinence of urine came on, with diminished energy of the genital organs and a fixed pain which extended from the occiput down to the shoulders. This, however, ceased after a time. On entering the *Maison de Santé* he had paralysis of the left nerve of the third pair, and the pupil of the left eye was more dilated than that of the right. Walking was most difficult and painful, nor could it be accomplished at all without looking at his feet. At night he crawled on his hands and feet to his bed. Still his muscles preserved their power, and they opposed themselves vigorously to any force used against them; and when placed in the erect position he could support a great weight on his shoulders. Sensation was tolerably perfect throughout the body, and he had had no other pain than that about the occiput. At the age of 38 he died from an attack of diarrhoea.

EXAMINATION thirty-four hours after death. — The cerebrum, cerebellum, pons Varolii, and medulla oblongata were slightly injected with blood, but no profound lesion appeared in any part of them.

The posterior columns of the spinal cord, however, were softened, and presented a yellow amber colour, especially in the lumbar region. The colour depended on a degeneration of the nerve tubes, most of which had disappeared. The anterior columns were also softened, but not to so great a degree as the posterior. The grey substance in the inferior fourth of its length had lost its consistence, and many of the fibrous tubes appeared to be ruptured. The caudate cells seemed shrivelled (*ratatinées*), and had undergone a certain amount of degeneration, but had not entirely disappeared. The capillaries were much engorged, and in the softened parts of the spine amorphous patches occurred in a hepatized state. The ganglia on the posterior roots of the nerves were swollen, unusually red from vascularity, and firm, the investing membrane thick. The ganglionic cells were covered with reddish yellow granules, some shrivelled, others larger than natural, but pale and spheroidal, almost like fat globules. The nerve filaments between the cells, yellowish in colour and degenerated, like the longitudinal nerve fibres. The fibres of the cauda equina flattened like bits of parchment steeped in water. The posterior yellowish, the anterior greyish. The anterior roots soft in the lumbar region, transparent, and grey in colour, the myeline apparently diminished. The motor nerves of the muscles of the orbit diminished in size, soft and greyish.

Before the experiments of Dr. Brown-Séquard proved that the posterior columns of the spinal cord are not the only channels of communication between the periphery and the brain, this case would have perplexed the physiologist more than it now does. It must be confessed, however, that in some cases of this progressive paralysis no morbid changes have been detected in the nervous centres; but in none of these latter, as far as I can determine, has the microscope been employed. In one case reported by Duchenne, it is expressly stated that it was not.*

It is impossible to ignore the resemblance between this disease and that which is known as *tabes dorsalis*. Both may be occasioned by onanism or by excessive venery; both give evidence to the existence of irritation in the spinal cord; in both enuresis and spermatorrhœa frequently occur; and in *tabes dorsalis* I have witnessed the occurrence of sudden fugitive pains in the legs and body. But the lesion of the cerebral nerves and the diplopia that results from it; the general extension of the disorder to the upper extremities; the preservation of muscular force, with the loss of power of co-ordination; and the progressive nature of the paralysis give it a distinctive character which appears to justify in a system of nosology “a local habitation and a name.”

I feel the truth of this the more strongly in consequence of a case which fell under my own observation, and in which I had the most satisfactory evidence that to neither of the causes alluded to above could the disease be attributed.

CASE 85.—G. C., Esq., aged 41, consulted me in 1845, having, as he informed me, been seized with paralysis of the arms and legs. Some six years before he had a severe attack of pain in the lower part of the back, which came on suddenly, without any ascribable cause and as suddenly left him, after having confined him to his bed three days. For about four years after he was occasionally inconvenienced by flying pains in the back and limbs, and in 1843 he began to feel insecure on his legs, and to experience sudden *sharp* pains in them, especially during the night. About six months after the occur-

* “De l'Electrisation Localisée et de son Application à la Pathologie et à la Thérapeutique,” deuxième édition, p. 608.

rence of these acute pains, eneuresis supervened, and I suppose, spermatorrhœa also, for he complained of having experienced great debility in the morning. He could walk, however, a considerable distance without much fatigue ; for, under the idea that country air and exercise were essential to him, he took a lodging at Shooter's Hill, and used to walk from thence to the City before his breakfast every morning. Notwithstanding every hygienic observance, the daily use of the shower bath and counter-irritants to the back, the disease increased. When I saw him he had become suddenly more infirm on his legs ; his arms and hands had become numb and weak ; the spasmodic pains, as they were described, were more severe all over his body but especially in his limbs ; the eneuresis had, to a great degree, subsided ; but he complained of double vision, yet was there no squint. Blisters, opiates, and tonics were of no avail. He was eventually taken from London, and I lost sight of him ; but I have been informed by his family that the pains became still more intense, and that "at last the limbs were quite contracted by being drawn up in the agony he endured." That after about two or three years he gradually became quite blind, and that his speech was much affected. That during the whole period of his illness his intellect was perfectly sound and his memory better than ever. He is said also to have had, from beginning to end, a spasmodic cough ; but I find no notice of this in my notes, although it is described as having tried him extremely by its violence. He died in the year 1854, aged 50. A few days before his death he appeared to have taken a severe cold, and his face swelled very much.

I was not then aware of the pathognomonic sign which M. Trousseau elicits from the patient with closed eyes, therefore I cannot speak of his power of sustaining the equilibrium of the body under such circumstances.

The experience of all who have had to treat the disease in question enjoins an unfavourable prognosis, even if the symptoms appear to be checked and to remain stationary for a time, as they are sometimes observed to do. It has never yet been cured.

With respect to the treatment, were the real nature of the affection recognized at a very early period, it is possible that its progress might be arrested, and it is probable that in galvanism or faradisation may be found the remedy for many of the characteristic symptoms. Duchenne records several cases of

diplopia which have so yielded, and he affirms that in some cases the fugitive pains have disappeared for a time under the influence of cutaneous faradisation.* Trousseau has found that form of electricity useful in subduing the pains, and he states that it appears, in some degree, to relieve the disordered movements. He has also derived benefit from the use of sulphur baths.

In October, 1863, a case of Ataxia was sent to me by my friend, Mr. Deacon, of Market Deeping. The patient, a gentleman, aged 60, had diplopia, flying pains in his limbs, enuresis, and great difficulty in maintaining his equilibrium, especially with his eyes closed. I advised the twentieth of a grain of strychnia to be taken night and morning, and the employment of very weak cutaneous faradisation. After five months' perseverance, I am informed by Mr. Deacon that "there is decided improvement, that the vision is not complained of, that the involuntary passage of urine is less frequent, and that the attacks of pain are few and far between."

When the disease appears as the result of syphilis, mercury and iodide of potassium naturally occur to the mind as remedial agents; but if the treatment be delayed until the loss of the power of co-ordination of muscles appears, neither is capable of doing good.

Some few years ago a case of transient diplopia, together with fugitive but severe pains in the lumbar region and abdomen, depending apparently on uterine irritation, fell under my observation; and, at the suggestion of Sir Charles Locock, the bromide of potassium was given with perfect success. There was no other disturbance of the muscular system, however, than a slight and evanescent strabismus.

M. Trousseau has relieved enuresis and spermatorrhœa by compressing the prostate gland; and I find the same appliance recommended by Dr. Thomas in his "Practice of Physic"† as having effected a complete cure.

Setons and moxas not only do no good, but they have been observed to aggravate irritation and to do positive harm.

* Loc. cit., p. 614.

† Sixth edition, p. 695.

*Paralysis from Granular Degeneration of the
Voluntary Muscles.*

The third form of progressive paralysis is that which I think is dependent on degeneration of the muscular fibre, and which I have elsewhere called *granular and fatty degeneration of the voluntary muscles*.* The French have given it the name of "*atrophie musculaire progressive*."

It may be recognized by the absence of any symptoms of central disturbance, difficult as it may be to conceive of any form of paralysis in which the nervous centres or conducting nerves are not implicated. The phenomena of the disease are those of weakened muscular power, which generally begins in the lower extremities, and extends by slow degrees to all the voluntary muscles.

In 1851 I communicated to the Royal Medical and Chirurgical Society a case of this description, together with the result of a *post-mortem* examination, in which no lesion was found in any part of the nervous system.

Previous to that time no account had been given of the precise nature of the disruption of muscular fibre which characterises this disease; and although I have hoped to see my opinion refuted by the demonstration of a nervous origin, it has been endorsed by most pathologists who have investigated the subject. It is not, as Duchenne has called it, a simple atrophy of muscles, but a breaking up of the sarcolemma of the elementary primitive fibres, and a segregation of the granules of which the sarcous matter is composed; therefore I still adhere to the term granular degeneration.†

* "Medico-Chirurgical Transactions," vol. xxxv., p. 73.

† M. Cruveilhier, in a "Mémoire sur la Paralysie Musculaire Progressive Atrophique," read before the Académie de Médecine, 15th and 31st March, 1853, has very accurately described the condition of the diseased muscles in the following terms:—"Dans les parties complètement décolorées qui à l'œil nu présentent la coloration jaune paille, on peut encore reconnaître des cylindres allongés, représentant les faisceaux primitifs du tissu musculaire. . . . La substance continue dans la membrane amorphe qui enveloppe chaque faisceau primitif a perdu l'aspect strié: elle est remplacée par une masse granuleuse uniforme présentant une foule de petits points gris (granulations moléculaires), qui par leur petit volume échappent à l'appréciation micrométrique. D'autres

On the day after the examination a youth of the same age (18) was kicked by a horse, and killed on the spot. My late friend Mr. Avery, who was then surgeon to the Charing Cross Hospital, procured for me the spinal cord, by which I was enabled to compare that of my patient with one that was known to be perfectly healthy, and I may state that in form, size, firmness, colour, and appearance under the microscope, the two corresponded in every respect.

I then alluded to a brother, four years younger, in whom the symptoms did not show themselves at quite so early an age; but the disease eventually made a more rapid progress, and he died in 1855 under somewhat similar circumstances—a mild attack of fever—at the same age.

CASE 86.—A third brother, W. P., was born in 1845, a well developed and healthy looking child, like the two former, but like them also he always sat heavy on his nurse's arms. When able to walk he could never make the slightest spring. In 1850 he was a full grown, healthy looking, heavy boy, and could effect a kind of run, but never with a spring. Like his two brothers at that age, when he ascended stairs it was with great difficulty, by holding the ballusters and dragging the leg which was furthest from them after him. This latter difficulty increased more rapidly than did that of walking on a level surface; but herein also he exhibited a gradual decreasing power, and by the time he was nine years old he could scarcely stand unsupported.

In this case, as in the two former, no reasonable suggestion in relation to change of habitation, regulation of exercise or of diet, was left untried; and a very intelligent servant gave his entire attention to such instructions, noting daily the apparent influence of every circumstance, according to which the diet was regulated.

grannulations brillantes, de nature graissense, sont éparsés et en assez grande quantité au sein de cette masse grnuleuse. Dans quelques points rares de la preparation, les cylindres présentent encore un aspect strié, mais que l'on ne peut apercevoir qu'après un examen tres-attentif, car il est complètement obscurci par la masse granuleuse.—“Gazette Médicale de Paris,” 23 année, Troisième Série, tome viii., p. 242. Compare this description of granular degeneration with that which I have given at page 105, of muscular degeneration after apoplexy; and the difference in the pathology will be at once apparent.

In 1854, Dr. Jephson, of Leamington, imagined that he was being fed too highly, and for two or three weeks great hopes were entertained that good was resulting from a change to a farinaceous diet with cream; but soon, the failing muscular power declined more rapidly than ever, and, with more nutritious food, he was sent to Nice for the ensuing winter. Still the disease advanced, and in the early spring, at the request of an Italian physician, and with the sanction of Dr. Travis, he drank the milk from a goat to which iodine was administered; at the same time he was carefully exercised, but all to no purpose. On his return to England in 1855 he was manifestly weaker and his arms were evidently implicated in the disease. He was then placed under the care of my friend, Mr. Skey; but in spite of a highly nutritious diet and every appliance, he died of a very mild attack of pneumonia in July, 1859, at the age of fourteen years.

Examination nineteen hours after death, carefully conducted by Mr. Savory. The body presented the appearance of a well-nourished youth, but there was a striking absence of rigor mortis. On making an incision from the interclavicular space to the pelvis, a tolerable layer of sub-cutaneous fat appeared; the clavicular portion of the pectoralis major was redder and higher in colour than the lower or sternal portion. The rectus abdominis red and healthy.

The thymus gland large, extending down to the second intercostal space, and healthy; the thyroid gland also large and healthy.

The pericardium healthy. Heart healthy in size, colour, and consistence; the right auricle somewhat distended with a black but firm clot; the lymph firm; the blood, *perhaps*, slightly decolourized; all the valves healthy; and the carnea columnae firm and healthy.

The lower two-thirds of the inferior lobe of the left lung in a state of pneumonic hepatization, but with mucus in the bronchial tubes—the hepatized portion sinking in water. The under surface of the lobe thus hepatized, covered with mottled patches on the surface of the lung, where a patch of extravasation also existed. The inferior lobe of the right lung also hepatized;

the remaining portions of both lungs healthy. Slight congestion of the bronchial tubes, the trachea also slightly injected.

Intestines healthy, but distended with gas; the mesenteric glands healthy; spleen full-sized; kidneys healthy in size, colour, and texture; bladder healthy; the solar flexus apparently healthy.

On opening the skull, the dura mater appeared to be healthy, and not unusually adherent; the brain generally healthy but somewhat large, firm in texture, and the colours well defined; the corpora striata and optic thalami well developed, firm and healthy; weight $57\frac{3}{4}$ ounces. It was, in fact, a thoroughly healthy brain.

The cellular tissue surrounding the dura mater of the spinal cord slightly œdematous; but the dura mater itself was healthy, as was also the spinal cord as regards size, firmness, and colour. Its weight $1\frac{1}{4}$ oz.

The chief structural change existed in the system of voluntary muscles, some of which, especially those of the lower extremities, were ochery in colour, and when examined under a microscope, in many places the striped elementary primitive fibres were found to be completely destroyed, the sarcous element being diffused about in the form of granular matter, whilst the sarcolemma or tunic of the elementary fibre was broken up and destroyed.

I have many carefully prepared microscopic specimens of the different tissues of the body, but in the voluntary muscles only am I able to detect unmistakable disease, and that, the disruption of their striped elementary fibres. Moreover, I am informed by Mr. Savory, that during a searching microscopical investigation, he failed to detect a vestige of disease in any part of the nervous system.

And such, I suspect, is the characteristic nature of the disease. From some cause there appears to be a diminished supply of arterial blood and defective nutrition in the diseased muscles, which are well nigh bloodless, just as is the case with bones in rickets. This is no mere fanciful analogy, for I shall have occasion to refer to a case in which there is reason to believe that the bones participate in the inadequate nourishment.

But M. Duchenne has referred my first case to a category of diseases which he has denominated "*Paralysie atrophique graisseuse de l'enfance*,"* and which he defines as nervous in character, resulting from some anteedent febrile affection, and terminating either in rapid recovery or degeneration of the affected muscles into fat.† I would beg to point out, however, that the cases which I have described have not presented a symptom of nervous disturbance, neither have they followed any febrile affection, nor have they resulted in the structural lesion which he has indicated. They have, in fact, nothing in common with the so-called "*Paralysie atrophique graisseuse de l'enfance*," except the failing of muscular power. The disease described by M. Duchenne begins and ends in childhood, and is peculiar to it; and although the case which I described incidentally began in childhood, I quoted others akin to it as existing in manhood, and I have yet to speak of others which have occurred in adult age.

Like M. Trousseau, I have observed that in the diseased muscles, a fibre here and there may be seen with its transverse striæ preserved, in the midst of many broken down fibres, in which the appearance of transverse striæ is lost; and this fact would appear to prove that the disease is not dependent on any affection of the vaso-motor nerves, for if it were, I suppose the degeneration would be more universal and more entire. And, by the same rule, were it a disease originating in the spinal nerves, the destruction of muscular tissue would proceed more generally—a fibre here and there would not preserve its striæ. I have not observed the great abundance of fat globules which he speaks of, except where every vestige of striated muscular fibres has disappeared; and there the vital power which belongs to the higher products of animal organization is so far weakened as to allow those tissues to yield to the physical and chemical influences which surround them, and to degenerate into fat.

Judging from the condition of the muscles in the case which I have just described, and the amount of muscular power remaining before the attack of pneumonia supervened, and

* "*De l'Electrisation Localisée*," pp. 505 et 286.

† *Ibid.*, p. 277.

comparing those circumstances with the more advanced stage of the disease, and the more helpless condition of his brother whose case I described in 1851, I should say that the muscular weakness coincides with the amount of muscular degeneration; and that it is in no degree affected by the cerebro-spinal system may be inferred, from the absence of any structural change in the brain, spinal cord, or nerves.

M. Trousseau has recorded the case of a *lady*, aged thirty, which is very analogous to mine, except that the Rhomboidei, the serrati, the sacro-lumbales, the psoas, and iliacus muscles were the first to be affected;* and the experience of M. Aran has led him to conclude that the muscles of the upper extremities are generally affected before those of the lower; but all agree in the opinion that whether it be in the arms or legs, the very last muscles to yield to this peculiar lesion are those which are subservient to respiration and deglutition.

The disease has a manifest tendency to hereditary transmission, and males are undoubtedly more obnoxious to its invasion than females. I have many instances which have fallen under my own observation to advance as evidence to these facts, and I trust that the following particulars of families may suffice.

That of which my young patient was a member consisted of four sons and seven daughters. Three sons have died of the disease, and the fourth is now the subject of it; the seven daughters are alive and perfectly healthy.

I am permitted to use the following statement relative to another family which has been given to me by a physician of eminence, in consequence of the great similarity of the cases to those which I have recorded.

CASE 87.—A very stout made, well formed, and in every respect healthy boy, sprightly, active, and intelligent, at the age of ten began to show weakness in the lower extremities, which gradually increased, and eventually required him to ask for assistance to raise himself from the floor. The infirmity is particularly marked when he attempts to ascend a stair. In walking the legs describe a semicircle as each is advanced. The youth is one of a numerous family, all the other children being healthy.

* “Clinique Médicale,” tome ii., p. 255.

The distressing peculiarity in this case is the distinct hereditary transmission of this affection.

His mother has three married sisters; one, who very early became a widow, has one daughter, now grown up and quite healthy. Another had two sons and one daughter. Both of the sons at a very early age became affected in a manner similar to that described above. The loss of power gradually extended to the upper extremities till they became quite helpless, requiring to be lifted from one chair to another and wheeled about from place to place.

The progress of the disease in both cases was centrifugal, the hands being the last affected. Their arms required to be lifted upon a table before they could amuse themselves, which they did in various ways, by writing, drawing, etc. Their intellectual powers were perfect, and they were cheerful and happy. The eldest, about 15, was dark, and very heavy for his years; the youngest, about 14, was quite the opposite, fair, red-haired, and much wasted from an affection of the chest, of which he died in 1846. His brother died a few days after, seemingly from a strong and deep nervous impression caused by his unfortunately witnessing his brother's suffering and death, leaving upon his mind the conviction that he also must die.

The third sister had a family of two daughters and one son, a very fine boy. He also began, very early, to shew some peculiarities in his gait, which gradually increased, and when he was 10 years of age there was no apparent prospect of improvement. The two daughters were perfectly healthy.

There is a marked peculiarity in all the members of the mother's family, which is a very uncommon developement of the gastrocnemii muscles.

CASE 88.—I observed the same centrifugal progress of the disease in a gentleman, who, at about the age of 65, in the year 1850, began to complain of a sense of heaviness and weakness in his legs, of which he was sensibly relieved on every occasion that he paid a visit in the country. I therefore advised him to take a house in Brighton, where he lived under the most favourable circumstances in regard to health, and had every attention paid him that money could command. But he became gradually weaker, and in the course of a few months was unable to raise himself from his chair. He was well

groomed by his servant every morning, and was drawn out daily in a bath-chair. His arms next became weak, and then his hands; and finally the muscles of the larynx became implicated, so that at last he could only utter monosyllables in a whisper. Throughout the whole course of the disease his intellect remained perfect; he never complained of pain, nor did he manifest a single symptom of nervous disturbance. All the involuntary muscles continued to perform their functions. In June, 1862, he came to Town to see the Exhibition, and one morning was found dead by his bed-side, having, by some means, rolled out during the night.

M. Trousseau refers to some cases in which he has observed cramps and muscular twitchings, or agitation of the diseased muscles, by minute contractile efforts. These phenomena I have never seen: on the contrary, the singular absence of every indication of nervous disturbance has obtruded itself on my mind.

The like absence appears in a case reported by M. Cruveilhier,* which occurred in a lady, aged 40, and which seems to have run a course remarkably similar to the last I have described, except that the upper extremities were more affected than the lower, and the distemper was of much shorter duration. It did not, however, the less deprive the sufferer of the power of expressing her thoughts, “although sensation, the special senses, the intellectual faculties, and the nutritive functions;” except so far as the voluntary muscles were concerned; remained perfect, and were regularly exercised to the last.

Neither pain nor muscular twitching is mentioned in the entire history of the case, notwithstanding which, M. Cruveilhier and other physicians who had seen this lady, diagnosed a lesion of the spinal cord, as did I in the case reported in the “*Medico-Chirurgical Transactions*;” but at the *post mortem* examination he found nothing, absolutely nothing, in the nervous centres, or in the conducting nerves to account for the paralysis.

In the muscles of the trunk and limbs, however, he detected bundles of fibres of various colours; those which had preserved their contractility being red, whilst those which had wasted, and had lost their contractility were of a rose or yellow colour,

* “*Gazette Médicale de Paris*,” Troisième Série, tome viii., pp. 236 *et seq.*, 16th Avril, 1853.

according to the amount of destructive degeneration they had undergone.

I have notes of some other cases to show that nervous symptoms are not apt to appear in granular degeneration of the muscles; and I have the permission of Mr. Delamotte, a surgeon at Swanage, the father of sixteen children, two of whom are subjects of the disease in question, to give the following details of the cases.

CASES 89, 90.—Miss A. D., and Mr. C. D., the seventh and eighth children of Mr. Delamotte, at about the age of 7, began to show symptoms of weakness in their legs, and when I saw them in 1855, the young lady being then 14, and the youth 12, they had each a waddling gait, and a difficulty in walking, the sense of weakness being chiefly referred to the loins; the most difficult motion was that of bending the thighs on the body, as in the act of getting up stairs. When sitting, both had remarkably healthy appearances; ruddy complexions, and well developed limbs. Their appetites were good, and all their bodily functions were regularly and healthily performed. They had cut their teeth easily, had never had fits of any kind, were never considered nervous, nor had they ever manifested a symptom of nervous disturbance during the whole course of their infirmity. Their intellectual powers were perfect. Mr. Delamotte has just favoured me with a visit (March, 1864), and informs me that the weakness is very slowly but progressively increasing; that in neither case has there been a pain complained of, nor a nervous twitching of a muscle observed. No cause can be assigned for the disease. The remaining fourteen children are perfectly healthy.

CASE 91.—William Yourns, aged 9, was admitted into the Middlesex Hospital under the care of Mr. Moore, in Oct., 1852, having for the four previous months been unable to sustain himself on his legs. He began to complain of weakness in the legs some eighteen months before he lost the power of standing. The gastrocnemii muscles had gradually become contracted, so that the heels were drawn up; by leaning on his bed, however, and extending his legs he contrived to move: but he was obliged to use his arms to support the weight of his body. When placed on his back he could bend his legs, and slightly move his feet and toes, but he could not bend his thighs on his body. My friend, Mr. Moore, kindly invited me to see the youth in Feb., 1853, at which period his arms were obviously failing in strength, for he moved them somewhat slowly, and he had lost the power of raising himself in bed by a suspended cord, which

he could do when first admitted into the hospital. When seen in bed he appeared to be a fine sturdy and healthy boy, and during the whole time that he remained under treatment, Mr. Moore assures me that he never manifested a symptom of nervous derangement. In that gentleman's notes of the case, with which I have been favoured, I find the following remarks:—The whole body is plump and firm, the limbs are of good size, and look quite natural. The muscles are firm, except perhaps the left gastrocnemius, which feels doughy when relaxed.

I would also refer the reader to the eight cases I quoted in my communication to the Royal Medical and Chirurgical Society,* in none of which was pain, spasm, starting, or any other sign of nervous disease complained of.

The first two cases described by M. Cruveilhier appear to have been similar to mine, and it is to be regretted that in the second case the spinal cord and the roots of the spinal nerves were not carefully examined, as it was proposed they should be; but, says M. Cruveilhier, “l'entraînement de mes occupations ne m'ayant pas permis de mettre tout de suite ce projet à exécution, à mon grand regret, le sujet fut enlevé; je constatai seulement à la simple vue que les nerfs des membres atrophiés paraissaient aussi volumineux que de coutume; que les nerfs musculaires, au moment de pénétrer dans les muscles atrophiés, présentaient, à peu de chose près, leur volume normal.”†

In neither of these cases, be it observed, is there a symptom alluded to which would lead to the suspicion that the nerves or nervous-centres were affected; but in the third case, of *Prosper Lecomte*, reported by M. Cruveilhier,‡ we read of quivering and starting of muscles; and the patient referred his suffering to two nights which he passed in the streets exposed to wet and cold. In this instance the anterior roots of the spinal nerves were found greatly diminished in volume. But I would venture to suggest that it is wrong to infer that because an atrophied state of the anterior roots existed in one case, which was traced to an exciting cause, and was attended with nervous symptoms, the same atrophy obtained in other cases to which no exciting

* Loc. cit., pp. 73—81.

† Loc. cit., p. 238.

‡ Loc. cit., pp. 230—233.

cause could be assigned, and in which no symptoms of nervous disturbance appeared.

And yet, on no other positive evidence, M. Cruveilhier regards the proposition as demonstrated, "that in the disease in question the atrophy of the anterior roots of the spinal nerves is the primitive lesion, and the muscular atrophy is the consecutive lesion."* I can well appreciate the difficulty of weaning the mind from the belief that, as all other forms of paralysis are dependent on affections of the nervous system, this must be so too. It is a part of our education to learn that the muscular system would be a mass of inert matter, were it not animated by nervous tissue; that by virtue of the association of nervous fibres with muscular fibres the latter are endowed with their sensibility and contractility; and I admit that disturbance of the nervous centres may favour the development of granular degeneration in individuals predisposed to it; but my observations have led me to the belief that this same degeneration may and does exist independent of nervous lesion.†

In a table, carefully prepared by Dr. Roberts, of Manchester,‡ there is a summary of the chief points in the history of 105 cases, of what he has denominated wasting palsy, or Cruveilhier's atrophy; but with great respect for that gentleman's opinion, I find but 28 in the list, including 8 reported by myself, that I regard as cases of granular degeneration of the voluntary muscles. In all the others, either there are no details given on which to found an opinion, or there is ample evidence to suspect either that lesions existed in the nervous centres, or

* Loc. cit., p. 245. I may here state, that in the examination I made of the spinal cord of G. P., whose case is described in the "Medico-Chirurgical Transactions" (vol. xxxv.), I traced the nerve-fibres of many of the anterior nerves into the anterior cornua; therefore I should have noticed an atrophied state of the anterior roots had it existed; but as M. Cruveilhier's *Mémoire* was not published until 1853 (April 16), my attention was not specially directed to the anterior roots of the spinal nerves.

† My friend the Hon. and Rev. Lord Sidney Godolphin Osborne, an accomplished microscopist, has for many years taken a lively interest in these cases of granular degeneration of the voluntary muscles, and has spent much time in examining the different tissues obtained at the post-mortem investigation made by Mr. Savory. In a letter to me he observes, "I am in my own mind quite satisfied that the peculiar paralysis about which you write to me, affords no direct evidence of lesion in any structure but the muscular."

‡ "An Essay on Wasting Palsy," p. 74—99.

in the peripheral nerves, or that a blood poison may have been the cause of paralysis.

Notwithstanding an earnest desire to find a central nervous cause, I am induced to believe in an idiopathic disease of the muscles, dependent, perhaps, on defective nutrition, just as there is an idiopathic disease of the bones, dependent on the same cause. And I consider that the consequent degeneration of the muscles is characterized by a breaking up of the amorphous membrane which envelopes the primitive fibres, and a dispersion of the contained granular matter;* that the muscles affected lose their power, in direct proportion to the amount and progress of the degeneration; and that the disease is not apt to be accompanied with symptoms of nervous disturbance.

Muscular twitchings in the affected muscles may, of course, be excited by friction or galvanism, as long as any striped elementary fibres retain their contractile energy; but these twitchings are not apt to occur spontaneously.

If those cases of local paralysis, besides the class we have considered as dependent on blood-poisoning, which we sometimes see in individuals engaged in certain crafts, as in lapidaries for instance, are modifications of the disease in question, an additional interest attaches to every circumstance connected with the development and progress of the infirmity. I have never had an opportunity of examining the muscles which are thus accidentally rendered inert; but, from cases I have seen, and others I have read of, I suspect the cause to be of a more mechanical nature. There are, however, some instances in which the disease may confine itself for a time to the extremities, but in which there is so manifest a tendency to a progressive extension, that I am disposed to regard such cases, when unaccompanied with nervous symptoms, as dependent on granular degeneration. Of the 60 cases tabulated by Dr. Roberts, in

* The breaking up of the sarcolemma is a different form of degeneration from the atrophy of muscles which supervenes on lesions of the nervous centres or on simple disuse. In these latter cases, fat globules abound between the primitive fibres, and the investing membrane does not break up. In M. Cruveilhier's third case he observes, "La membrane amorphe (*sclerema*) qui enveloppe chaque faisceau primitif, est conservée, mais la substance contenue a perdu l'aspect strié."

which the disease was confined to the extremities, some 10 or 11 evince such tendency.

I have notes of a case in which all the muscles of the thumb supplied by one branch of the radial nerve—the opponens pollicis, the flexor pollicis brevis, and the adductor pollicis, have become gradually paralyzed.

CASE 92. — Miss S., aged 26, has for the last two years (1861) experienced a gradually increasing weakness of the thumb of the right hand; which is more or less painful when she attempts to use it, as in writing, for more than two or three minutes. Her general health is in every respect good. Notwithstanding the long continued use of galvanism and strychnine, the muscles of the thumb have become gradually weaker, but vary from time to time,—occasionally, as she informs me, she can write a few words, at other times she cannot, but is reconciled to the loss, being able to write with the left hand. The electro-muscular irritability is sensibly less than that evinced by the corresponding muscles of the left thumb. The only cause to which my patient can attribute the infirmity is over-exertion of the hand on the piano-forte.

Now in this case the affected muscles are so obviously limited to those which are supplied by a special nerve, and the palsy has proceeded so generally and so equably, that I have never for a moment entertained the idea that this is a case of granular degeneration.

DIAGNOSIS.—A progressive paralysis, assignable to no exciting cause, wherein the sphincter muscles are not apt to be implicated, and in which no symptoms of nervous disturbance appear, is, according to my observation, diagnostic of granular degeneration of the voluntary muscles.

It is scarcely possible to give a more graphic delineation of every character of this disease than is contained in a letter from a gentleman in Somersetshire, the father of the family alluded to; and he has kindly permitted me to quote it. “Dear Tom died February 3, 1858, after two days’ illness. He complained of cold on Sunday, and on Tuesday he died; but his general health was good to the last. He died at 16, and was afflicted nine years. We have lost six boys. Ben is now 9 years old, and very like dear Tom. Willie, the last boy, though he had a

wet nurse, in consequence of an idea on my part that it would make a difference, is far from strong. All the girls—four in number—are healthy and strong.”

In this short, but expressive abstract, we have the history of a family in which eight boys have been affected* without any assignable cause; in whom the disease has run its course, with one exception, without one symptom of nervous disturbance; and in which all the females have been left intact.

The exception alluded to consists in paroxysms of pain in the bowels, from which the eldest of the two surviving brothers, B. C. W., occasionally suffers; each attack being followed by tenderness, so that he can scarcely bear to be touched for a day or two after. This poor youth, now 13, has been unable to walk for the last year past; neither can he dress himself, nor even raise his hands to his head without resting his arms on a table.

The youngest brother, W. W., aged 8, is unable to walk as well as his brothers did at the same age; and in this youth the bones appear to be implicated in the defective nutrition, for he has twice broken his thigh of late, by simply falling on the floor. Once when putting on his coat, and the second time when attempting to walk across a room.

This is the case to which I have before alluded, as illustrative of the analogy between two idiopathic diseases dependent on defective nutrition; the one affecting the bones, the other the muscles.

PROGNOSIS.—The disease under consideration, like every other, demands from the physician a correct estimate of the importance of the affected organ, as well as of the nature of the structural lesion, in order to arrive at a definite judgment as to the result. Now, the voluntary muscles are not essential for the maintenance of animal life; but there is an intimate relationship between their power and activity, and the functional energy of the vital organs; consequently, when the physical force of the contractile agents is destroyed, the enfeebled action of the viscera is easily extinguished. This fact has been illustrated in every fatal case which I have described; and as muscular fibre is not regenerated when once broken up, the prognosis in granular degeneration is therefore very unfavourable.

* The above letter was written in 1859.

TREATMENT.—There is no disease in which the indications of treatment seem to be more clear, and the symptoms more manageable, than they are in this form of paresis, nor is there any in which the utter inadequacy of every remedy to accomplish the cure is so provokingly experienced.

A well developed, sturdy looking youth, with ruddy face and ample limbs is presented to you, having every faculty of the mind in full activity; and every function of the body, save that of locomotion, efficiently performed. That exception gives him a heavy and inactive gait. If any little derangement of his general health occurs, it is easily rectified, and his lumpy movements suggest to the mind the foot-ball and skipping-rope, as the most appropriate remedies; but he falls in attempting either. And in spite of exercise regulated by the most careful and constant supervision; of food prescribed by the last word of physiology as the most appropriate; of climate varying from alpine heights to the sea level, and from the shores of the Mediterranean to those of the German Ocean; of electricity in all its forms; of almost every nervine tonic contained in the pharmacopœia; and of every conceivable hygienic appliance; the disease has pursued a progressive course such as I have described.

But if the disease be dependent on an alteration in the composition of the muscular tissue—the healthy affinities being annulled and new ones set up—surely some remedy should be found which has the power of modifying the morbid process of assimilation, and of inducing a healthy one, so as, at least, to arrest the course of disease, if not to effect a restoration.

With this feeling, it occurred to me that as arsenic has a peculiar preservative action on dead animal tissues, it might also be the means of preserving living fibres from a disorganization, which appears to result from malnutrition; and I think it will be found that it has such power. My experience of its effects has not yet been sufficient to justify a more decided opinion, for in one case only have I given small doses of Fowler's solution, and in that the progress of the granular degeneration appears to be arrested.

It is possible, however, that the sanative measures which have been adopted, may have given tone to the muscular mass which

still retains its structural integrity ; and that an illusory service only has been acquired. But if the gain be persistent, I should be further disposed to give the hot sulphurous waters of Aix-la-Chapelle another trial, on the faith of Dr. Wetzlar, who assures me that he has employed those mineral waters in cases of the so-called progressive muscular atrophy, with considerable success.

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